1996

Perceptions of agricultural educators regarding the role of agricultural mechanization in the secondary agricultural education curriculum

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Perceptions of agricultural educators regarding the role of agricultural mechanization in the secondary agricultural education curriculum

by

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A dissertation submitted to the graduate faculty

in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

Department: Agricultural Education and Studies

Major: Agricultural Education (Agricultural Extension Education)

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Iowa State University

Ames, Iowa

1996

UMI Number: 9712598

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CHAPTER I. INTRODUCTION

In the past several years, many articles have been written and several studies undertaken, that address the need for change in agricultural mechanization education in secondary agricultural education programs (Eighmy, 1995; Shinn, 1995; Laird, 1994; Buriak, 1992; Osborne, 1992; Slocombe, 1986). One of the most prominent studies addressing changes in agricultural mechanization was a study undertaken by the National Research Council (NRC, 1988). The NRC established the Committee on Agricultural Education in Secondary Schools to assess the state of agricultural education in America.

Agricultural Education has a long history in American education. When Agricultural Education became federally funded in 1917, approximately 33% of the U. S. population lived on farms. Today, only about 2.2% of the total U.S. population lives on farms; farming methods have become more sophisticated; and yields and the area of land under cultivation have increased (NRC, 1988). New technologies, scientific revolutions, and global influences are changing the face of American agriculture daily. These changes in agriculture necessitate change in agricultural education as well.

The committee's findings indicated that much of the focus and content of today's vocational agriculture programs is out of date. Production agriculture still dominates many agricultural education programs, even though a smaller percentage of people are actually engaged in production agriculture. There are broader needs in agricultural education that reflect the changes in America's food and fiber industry that need to be met by refocusing the content of agricultural education programs (NRC, 1988).

Additionally, the council found that vocational agriculture programs are uneven in quality. Good programs need to be supported, built upon, and replicated. Programs not meeting educational needs should be upgraded, consolidated, or phased out. Applied learning should continue to be stressed, but instruction in science, technology, economics, agribusiness marketing and management, international agriculture and public policy should be strengthened (NRC, 1988). The council also was concerned about how teacher education programs in agricultural education were preparing their teachers.

The need for change in the agricultural mechanics education was emphasized by Buriak (1992). He stated that many agricultural educators view agricultural mechanics as a non-essential area, with the move to a more science-based curricula and less agricultural mechanics required for teacher certification.

However, a more science-based agriculture curriculum lends itself directly to science applications in agricultural mechanics. Physical science applications and mathematics are the foundation for instruction in agricultural mechanics (Buriak, 1992). The agricultural industry is increasingly technologically-based. As technology becomes more sophisticated, the links to science become stronger, and students need the opportunity to explore and understand the scientific basis of agricultural mechanics.

Agricultural mechanics provides the opportunity for students to experience applied physical sciences and mathematics within an agricultural context, emphasizing the principles, concepts and laws of science, and their mathematical relationships that support and explain agriculture (Buriak, 1992). Agricultural mechanics needs to be taught with these concepts in mind.

According to Osborne (1992), agricultural mechanics programs must do more than teach skill development and project construction. Agricultural mechanics must be taught as applied physical science with math concepts and principles. There must be a shift from a product focus to a process focus (Osborne, 1992). The focus must be on the "why" a practice or skill is performed. The author also stated that the goals and objectives of agricultural mechanics need to be re-examined, and curriculum re-designed to help teachers accomplish the objectives of the program.

A study conducted by the Council for Agricultural Education, Agricultural Mechanics Task Force, examined curricular issues in the secondary school agricultural mechanics program area (Shinn, 1995). The strengths of the agricultural mechanics program were found to be that it emphasized active learning by doing, and that it developed positive self-esteem among students, especially under-achievers (Shinn, 1995). The study (Shinn, 1995, p. 25) found the limitations of agricultural mechanics as it has been taught include:

1. Lack of funding for modem equipment, technology and general lab supplies.
2. Lack of an application of the principles of math, science, and technology.
3. Program based on past needs and experiences.
4. Program not addressing higher level technology skills.
5. Uses projects that are not appropriate for the "new" agricultural industry.
6. May not meet the needs of the new agricultural worker (electronics, controls, robotics).
7. Program has a negative image caused by poor housekeeping.

The Shinn (1995) study represented only one perspective, that of a panel of experts that was critical of the current agricultural mechanics program. The panel was made up of faculty and administrators from agricultural education, agricultural engineering, colleges of agriculture, and state departments of education. Additional perspectives from industry, program completers, and current students in agricultural education were called for to establish criteria for re-engineering the curriculum.

Eighmy (1995) conducted a study to provide information to assist faculty and administrators in analyzing the future role of technology-related education in K-12 programs. The study also sought to develop appropriate strategies for meeting the needs of students enrolled in teacher preparation programs and in-service education classes (Eighmy, 1995). Major findings of this study indicated that agricultural mechanics instruction in most high school agriculture programs is not adequately addressing the needs of students. Therefore, the structure and content of these programs require revision.

The study also pointed out the lack of a "vision" at the national, regional, and state levels for what the future role of technology-related instruction should be in secondary agricultural education programs (Eighmy, 1995). A re-evaluation of teacher preparation programs in technology-related education was also called for.

Clearly more direction is needed in the field of agricultural mechanization for curriculum development, improvement, and delivery. Osborne (1992) stated:

> As we continue to improve the secondary curriculum, agricultural mechanics must be reexamined and reshaped along with other curriculum specializations. When compared to other segments of the curriculum, agricultural mechanics may hold the greatest potential for addressing a blend of literacy, vocational, applied science, and basic study objectives. (p. 4)

Statement of the Problem

There is a need for change in the agricultural mechanics curriculum and the delivery of these programs in particular. As agriculture and technology continue their evolution, agricultural mechanization instruction must continually reflect that evolution. A continual process of rethinking, restructuring, and reshaping of agricultural mechanization education is needed.

Studies have been conducted to determine perceptions of teacher educators and administrators regarding the changes needed to be made, but there is a lack of input from the secondary school agricultural educators regarding their perceptions of agricultural mechanics as it now exists and the need for change.

Purpose

The purpose of this study was to determine the perceptions of agricultural educators regarding the role of agricultural mechanization in the agricultural education curriculum in secondary schools throughout the Central Region of the United States. The study sought to draw implications to teacher education programs to provide direction for enrichment of the curriculum.

Objectives

The objectives of this study were to:

1. Identify perceptions held by secondary school teachers regarding selected concepts in agricultural mechanization education.
2. Determine instructional areas in agricultural mechanization currently being delivered in secondary agricultural education programs.
3. Identify the degree to which instructional areas in agricultural mechanization could be expanded in future agricultural education programs.
4. Identify selected demographic data of secondary school teachers of agriculture.
5. Design a practical curriculum model for development of agricultural mechanization in agricultural education programs.

Need for the Study

As American agriculture is changing, agricultural education must keep abreast of the changes in order to adequately prepare students to function within the new and continually changing agriculture industry. In no area is this more true than in agricultural mechanics, where science and technology are leading these changes. There is a need to address the limitations of current programs of agricultural mechanics and propose revisions for the curriculum of the future. By determining what is currently being taught, as well as identifying what agricultural mechanics instructional areas secondary instructors would like expansion in, a new direction for agricultural mechanization instruction within agricultural education can be charted. Designing a practical curriculum model for development of agricultural mechanization within agricultural education would provide a framework for the agricultural mechanics program of the future.

There is a lack of research within the field of agricultural mechanics (Hill, Harper, & Symons, 1988; Osborne, 1992; Williams, 1991). Williams (1991, p. 12) stated that "Agricultural Education has a critical role to play in the transfer of agricultural technology. For the discipline to realize its full potential, research is needed to light the way."

Hill et al. (1988) stated:

> We are lacking a broad base of research pertaining to agricultural mechanics education. As pressure continues for more economically efficient agriculture, the need will become even greater. The development of a systematic research program in agricultural mechanics is vital to the future of agriculture. (p. 23)

Therefore, more studies need to be undertaken in this area to help determine the scope and direction the program needs to take. Within the research that has been done, there is a lack of input from agricultural educators. One study was found, undertaken in 1987, which sought to determine teachers' perceptions of the value and need for agricultural mechanics content in an undergraduate degree program (Burke & Hillison, 1988). Agricultural educators are the ones "in the trenches," teaching the agricultural mechanics curricula, therefore it is critical to solicit their input.

Implications and Educational Significance

The findings of this study contributed to a better understanding of the characteristics, status and direction of agricultural mechanization education in 1996. The study provided significant insight into the principles and practices of today's agricultural mechanization curriculum, as well as providing a focus for change within the curriculum. The study added to the body of literature in agricultural mechanics education, providing insight to guide decision makers in setting priorities for curriculum content and in teacher preparation programs. A practical curriculum model was designed for development of agricultural mechanics in secondary agricultural education programs, to further assist agricultural mechanics educators in the process of curriculum improvement and redesign.

Definitions of Terms

The study was conducted using the following operational definitions of selected terms:

Agricultural Education - Education related to the agricultural sector of the industry known as agriculture including the applied sciences of agriculture.

Agricultural Educator - A person who facilitates learning in and about agriculture.

Agricultural mechanics/mechanization - The development of the basic mechanical knowledge, skills and abilities of students in agricultural physical science applications; science-based, applied physics applications in agriculture.

Curriculum - The formal and informal content and process by which learners gain knowledge and understanding, develop skills, and alter attitude, appreciations, and values; the curriculum can be planned or hidden (Doll, 1992).

Curriculum model - A simple representation of the complex relationships known as curriculum; a description or analogy used to help visualize the curriculum.

Instruction - The action, process, practice, or profession of teaching.

Perception - Knowledge and insight gained through one's senses, an extraction of knowledge (information) from an individual.

Physical science - The natural sciences, such as physics and chemistry, that deal primarily with nonliving materials.

Process focus - Attention given to a series of actions or operations in an activity.

Product focus - Attention given to the end result of an action, what is produced.

Science-based - That which has its foundation in the sciences.

Teacher Educator - A person skilled in the theory and practice of education that instructs other educators.

Technology Education - Education related to the understanding and use of technology and its effects on individuals, society, and civilization.

Vocational Agriculture - Education in agriculture; gives students the skills needed to enter and advance in agriculturally related careers; prepares students to further their education in agriculture at post-secondary schools and colleges.

Vocational Education - Education in skills or trades, primarily in preparation for career opportunities.

Summary

There is a need for change in the content and delivery of the agricultural mechanics curriculum within agricultural education. The purpose of this study was to determine agricultural educators' perceptions of the current agricultural mechanization curriculum, to provide insight and guidance in the process of curriculum improvement and redesign, and to develop a practical curriculum model for agricultural mechanics within agricultural education.

CHAPTER II. REVIEW OF LITERATURE

Introduction

We live in an increasingly global society. As our world gets smaller, the changes taking place in the global society affect those of us in our respective countries at an ever increasing pace. Kennedy (1993) identified four forces at work in global change: population growth, impact of technology, environmental damage, and migration. Each of these forces bears a direct impact upon agriculture and those involved with agriculture.

The world population has more than doubled since the 1950's, and is projected to possibly double again by the year 2025 (Kennedy, 1993). The world population is increasing faster than the world capacity for food production. Changes in technology are occurring at an astounding rate. Concerns about environmental damage are being expressed and explored, raising questions about current practices as well as technological advances. Lastly, migration of people from rural areas to urban communities is continuing at an alarming rate, raising the questions of who will be producing the needed food, and what will be done with the overflow of manpower in the cities (Kennedy, 1993)?

Education will play a major role in the preparation of the global society for the twenty-first century. This education must include teaching an understanding of why and how our world is changing, and how all peoples and cultures are affected by those changes. As technological innovations create new jobs and destroy old ones, we will need to rethink, retrain, and retool for the future (Kennedy, 1993).

The changes in American agriculture parallel the changes throughout the world. A scientific and technological revolution has swept across America. Whereas, at the turn of the century American farms were largely self-contained enterprises, today, farmers have come to rely on others for information, services, and production inputs (National Research Council, 1988). Farming has become much more complex, with today's farmers engaged in all facets of the food and fiber industry including but not limited to: production, processing, marketing, distribution, and financing. The number of farms has been steadily decreasing, while the size of the individual farm has increased. Fewer Americans are farming today than ever (NRC, 1988).

Agricultural Education has been evolving just as the agricultural industry has. The National Research Council (NRC) established the Committee on Agricultural Education in Secondary Schools to evaluate the contributions of instruction in agriculture to the maintenance and improvement of agricultural productivity and economic competitiveness of the United States (NRC, 1988). The committee found that agricultural education needed attention in two distinct areas. First, agricultural education needs to become more than vocational agriculture. Second, significant revisions are needed within vocational agriculture (NRC, 1988).

Agricultural mechanization education within secondary school agricultural education must be reexamined and revised just as much as any of the instructional areas within secondary school agricultural education. Several studies (Eighmy, 1995; Laird, 1994; Shinn, 1995) have addressed the issue of the need for change within the agricultural mechanization curriculum in agricultural education, and provided recommendations for future programs. It has been recommended by several researchers to investigate the perceptions of teachers of agriculture, business and industry, and other interested professionals. This study focused on teachers of agriculture at the secondary school level.

To understand what direction agricultural mechanization within agricultural education must take in the future, it was necessary to examine and understand its past. The philosophical foundations for the discipline, as well as issues affecting curriculum and instruction were explored from an historical perspective.

A Brief History of Agricultural Education

Agriculture was first taught in a formal manner in the United States in Georgia in 1733 (NRC, 1988). Colonists were attempting to learn more about native crops and cultivation techniques. An orphans' school was founded in Georgia in 1734, where children were taught farming techniques.

According to Stimson and Lathrop (1942, in Eighmy, 1995), George Washington was involved in the early development of the agricultural movement in America. He, Benjamin Franklin and others of that time were influential in starting the first society for the promotion of agriculture, the Philadelphia Society for Promoting Agriculture, in 1785 at Philadelphia. Similar societies began appearing in several eastern states, leading to the establishment in 1801 of the first agricultural fairs and exhibitions (Eighmy, 1995).

By the early 1800's, many states had established boards of agriculture to oversee agricultural interests. National agricultural organizations such as the Patrons of Husbandry (Grange) and the National Farmers' Alliance were organized at this time, as well as various breeders' associations and state disease and sanitary boards (Eighmy, 1995).

In the early 1800's, agriculture was offered in some schools. Practical work, in the fields and in shops working on farm equipment, was interspersed with classroom instruction in the science and theory of agriculture. The instruction was limited because of the lack of a body of agricultural knowledge for use in the secondary schools at that time (Eighmy, 1995).

With the formation of local agricultural groups across the nation, state agricultural societies were assembled, and in 1852 the United States Agricultural Society was formed (Cochrane, 1979). One of the main activities of these state and local agricultural societies was to push for the creation of scientific, industrial, and technical agricultural schools; and to support them once they were established. The first agricultural colleges were begun during this time period. In Pennsylvania in 1854, a "Farmers High School" was begun, with the intent of educating the youth of Pennsylvania in the areas of science, learning, and practical agriculture as they related to each other. The school later became the Pennsylvania State College and is now the Pennsylvania State University (Cochrane, 1979).

During the 1850's, increased efforts were made to establish a system of state agricultural colleges across the nation. The passage of the Morrill Act in 1862 finally paved the way for the establishment of more formal agricultural education. The purpose of the legislation was the endowment, support, and maintenance of at least one college in each state, where the emphasis of studies would be in areas relating to agriculture and the mechanical arts. The challenge then was to find professors to teach agriculture at this level, develop the sciences themselves, decide what was to be taught, and to find the students to be taught. Many students with the necessary secondary background aspired to fields other than agriculture such as medicine or law, whereas students interested in technical agriculture often lacked the secondary education necessary for admittance to college (Cochrane, 1979).

Some colleges admitted these students and provided remedial courses. Others established separate secondary schools of agriculture such as Minnesota and Nebraska (Eighmy, 1995). During this time, efforts were begun to include agricultural courses in public high schools in rural America. It was hoped that this would better prepare students to enter agricultural and mechanical arts in the land-grant colleges. Agricultural instruction was to prepare students to be broad-minded, progressive citizens, homemakers, farmers and horticulturalists. Instruction was not to be strictly vocational (True, 1929).

College programs developed courses of study, of which agricultural engineering was one. Experiment farms were also utilized. Agriculture courses within the departments provided study in such areas as surveying, leveling, and the mechanical arts as they applied to agriculture including planting and tillage equipment, harvesting equipment, manure handling, buildings, forage work, etc.

(Eighmy, 1995). In 1903, the committee on instruction in agriculture of the Association of American Agricultural Colleges and Experiment Stations continued the organization of courses and faculties within agriculture (True, 1929).

As part of a general course in agriculture, rural engineering was defined as "the science and art of laying out farms, designing and constructing farm buildings and works [including water, irrigation, drainage, and sewage systems, and roads], and the construction and use of farm machinery" (True, 1929, p. 252).

In 1904, 125 students were enrolled in this department at the Iowa College, and a special building was erected for farm mechanics instruction and shop activities. Similar buildings were constructed and departments set up at other agricultural colleges. In 1910, the Iowa State College offered a four year course in agricultural engineering leading to a bachelor of science degree (True, 1929).

During this time period, many states passed legislation supporting appropriations for establishing and maintaining agriculture, mechanic arts, and home economics instruction in the secondary public schools. Instruction at this time did not have the vocational results expected.

The movement toward providing industrial vocational education in the secondary schools was led by the National Society for the Promotion of Industrial Education (NSPIE). It included education in agriculture and home economics.

However, in 1917, with the passage of the Smith-Hughes Act, "vocational agriculture" more or less replaced general agricultural education in the schools. The act set up a federally funded vocational education program that included specific provisions for agricultural education (NRC, 1988). These programs were designed to educate young people for farming careers, as well as disseminate information about agricultural innovations. Still, not all educators agreed with the shift to a vocational approach for agricultural education (Eighmy, 1995).

Teachers used various means to teach the agricultural content and processes including classroom instruction, projects, supervised experience and entrepreneurship. Topics covered included but were not limited to: agricultural production, supply and service industries, agricultural mechanics, agricultural business, ornamental horticulture, agricultural resources, forestry, and agricultural technology. The Future Farmers of America (FFA) was founded in 1928, providing another means of active involvement of students in agricultural activities, as well as leadership opportunities.

The early years following the Smith-Hughes Act establishing vocational education in agriculture were spent building the foundation of the program. According to Eighmy (1995), significant developments during those years included the development of specific units within farm mechanics, the building and equipping of farm shops, the improvement of home farm situations, and refinement and improvement of teaching methods.

What was taught was largely left up to the farm mechanics instructor. Nickell and Simon (in Eighmy, 1995) stated that the teacher should develop and guide the interests of his students and that courses should change to meet changing conditions and practices on the farm; these were indications of progress. They cautioned that if a teacher failed to keep up with the changing technology, the teacher would likely over-emphasize work that was becoming outdated.

During the 1960's and 1970's the term "farm mechanics" was replaced by the term "agricultural mechanics." The Vocational Education Act of 1963 focused on providing quality vocational education in agriculture, and the Vocational Education Act of 1968 helped in the development of two-year post secondary agricultural programs (Eighmy, 1995).

As the agricultural education curriculum changed to meet the new, off-farm agricultural occupations, urban students began taking courses in agricultural education. Agricultural education began preparing students for off-farm occupations.

Agricultural mechanics continued to be an important part of the agricultural education curriculum. Agricultural power, machinery and equipment, electrification, soil and water management, agricultural buildings, and basic shop skills were all a part of the curriculum.

Many factors were at work worldwide which were changing the face of American agriculture and education. A study was undertaken in 1985 to address concerns about the declining profitability and international competitiveness of American agriculture, along with concerns about agricultural education programs: their declining enrollments, quality, and instructional content (NRC, 1988). The National Research Council established the Committee on Agricultural Education in Secondary Schools to assess the state of agricultural education in America.

The committee found that, although vocational agriculture programs have had a positive effect on tens of thousands of people, many vocational agriculture programs are outdated and are in need of being revised. Production agriculture remains the dominant force behind the programs, yet it no longer represents a major proportion of the jobs available in the agricultural industry. The subject matter must be broadened, and exemplary programs studied and duplicated. Teacher preparation and in-service training programs should be revised and expanded. Programs should continue to utilize applied learning, but should improve instruction in science, technology, economics, agribusiness marketing, international agriculture and public policy (NRC, 1988).

Agricultural Mechanization Education

With the curriculum changes in agricultural education and the move towards more science and math-based courses, some people have wondered where this leaves the agricultural mechanization portion of the curriculum. According to Osborne (1992), many agricultural educators today are concerned that agricultural mechanics instruction is being forgotten in the curriculum reform movement. Osborne also contends that some agricultural educators think agricultural mechanics contradicts rather than compliments science-based curriculum reform. Buriak (1992) somewhat agrees stating that agricultural mechanics is viewed by some agricultural educators as a non-essential area of instruction. In addition, many states are requiring less and less agricultural mechanization for teacher certification.

Agricultural mechanics has been a major part of the secondary agricultural education curriculum from its inception. From the beginning, agricultural mechanics was structured to prepare individuals to return to a farming enterprise. Students needed a wide range of knowledge and skills about machinery, electricity, storage structures, livestock housing, environmental systems and soil and water issues. Teaching was primarily skill-based and project-oriented, coming under the title of "Production" (Buriak, 1992). Following this program, students usually entered production agriculture.

Buriak (1992) contends that today this program is not viable. Agricultural mechanics must be science-based, applied physics with applications in agriculture. This move towards agriscience within the agricultural education curriculum gained momentum in Orlando at the Conference for Agriscience and Emerging Technologies in 1988. Educators from many states attended and returned to their institutions to direct efforts to incorporate more science into agricultural education instruction (Buriak, 1992). Science educators were more comfortable with teaching the biological sciences. So innovations of science into the agricultural education curriculum have been for the most part based on the biological sciences.

The physical sciences and mathematics are the foundation for agricultural mechanics curriculum and instruction. If agricultural educators lack the knowledge of physical science and its role in agriculture, instruction in agricultural mechanics will be lacking. As the agriculture industry is increasingly technology-based and the links to science become stronger, students need to understand the science controlling and explaining technology and how it relates to agriculture.

Osborne (1992) agreed, stating that agricultural mechanization should be taught as an application of physical science and math concepts and principles. Physics and chemistry concepts must be studied and understood in order to describe practices in agricultural mechanics. Further, Osborne felt there must be a shift from a product focus to a process focus within the curriculum; with an emphasis on basic understanding of the way things work.

Krueger and Johnson (1992) stated:

> In agricultural education a proven vehicle that can provide experiential learning in applied physical science is agricultural mechanics. It provides a context for direct, systematic application of scientific knowledge in developing and applying technology. It encourages student development of collaboration skills—the ability to be a team player, a person who can cooperate on a task. Students will also begin to display a "can do" attitude as well as show adaptability in a "learning by doing" environment. (p. 16)

Much of the subject matter taught in the secondary agriculture classroom is founded in the academic basics of math and science (Lawver & Fraze, 1992). The authors argued students undoubtedly benefit in agriculture programs where academic subject matter is reinforced. It also helps to better prepare students that are going on to the college level. Additionally:

> Even the most traditional and routine instructional areas such as welding, agricultural power and machinery, agricultural structures, and others can become new and exciting simply by recognizing the fact that agricultural mechanics is applied science and then teaching in the appropriate manner. (Lawver & Fraze, 1992, p. 10)

Lawver and Fraze (1992) give an example of identifying scientific principles that can be incorporated into welding instruction. In addition to teaching the skills necessary to weld and construct a project, also included are the scientific principles behind welding including electricity, chemical reactions, and properties of metals. Six ways of incorporating scientific applications in the teaching of agricultural mechanics are listed by Lawver and Fraze (1992):

1. Develop an attitude that science is a component of agricultural mechanics.
2. Look for commonalities in agricultural mechanics and physical sciences curricula.

3. Identify scientific principles which are currently being taught.
4. Incorporate additional scientific principles which should be taught.
5. Emphasize these scientific principles when teaching.
6. Reinforce these principles when working in the agricultural mechanics laboratory to ensure the transfer of knowledge to application. (p. 11)

Students would benefit twofold by the reinforcement and enhancement of science instruction that students have already received in their general education courses. First, once students understand the science principles behind a certain skill, the skill might prove easier to master. Second, students might develop a greater interest in their academic subjects once they had experienced a practical application (Lawver & Fraze, 1992).

Gliem (1992) discussed the importance of being competent in basic mathematics in order to understand the concepts and relationships involved in any of the sciences, particularly the physical sciences, and then to use these principles when teaching agricultural mechanics. As examples, lessons on power and lessons on calibration of sprayers both offered the opportunity to make use of basic math skills and the application of scientific principles. Gliem called for prerequisites in mathematics and science for upper division agriculture courses, and in-service training for teachers who are weak in mathematical problem-solving and application of scientific principles in the agricultural mechanics curriculum.

Opportunities for inclusion of physical science and mathematics within the agricultural mechanics program come with integrated instruction across content areas. Schrader and Litchfield (1992) stated that the study of foods provides an excellent means for physical science, chemistry and mathematics principles within the mechanical aspects of food technology to be explored. Equipment, buildings, automation, electronics and physical processes are some of the subjects that lend themselves to integrated instruction between food science and agricultural mechanization.

Environmental issues in agriculture also provide a means to integrate agricultural mechanics within another content area; students must learn about the environmental processes and the impact of agricultural practices to be able to effectively maintain a high level of production while protecting the environment. Environmentally sound mechanization knowledge and skills will be increasingly demanded as the push for a sustainable agriculture continues. According to Hirschi (1992), knowledge of environmental issues opens totally new career opportunities for students. Environmental engineering firms are recognizing the many talents of agricultural mechanization graduates, and hiring them to perform technical duties that require knowledge of environmental processes.

In a paper presented to the American Society of Agricultural Engineers, Slocombe (1986) addressed the issue of agricultural mechanization curricula for the year 2000. Slocombe felt that mechanization developments will be concerned with conservation of soil and water, expert systems used to make management decisions, and more efficient power and machinery units. Curriculum will adapt to these changes and emphasize communications, management, science and technology (Slocombe, 1986).

Harper and Buriak (1995) also provide guidelines for the planning, organization, delivery and evaluation of curriculum in agricultural mechanics, and encompassing the entire realm of "Agricultural Systems Technology Management" which includes agricultural, biological, environmental and food engineering technologies, as well as agricultural mechanization systems. Principle-driven instruction involves the understanding of a simple principle and building upon that to more complicated applications (Harper & Buriak, 1995). Agricultural technology is based upon a combination of principles. According to Harper and Buriak, there are four broad areas of principles within agricultural technologies: basic sciences principles; applied science principles; technological systems principles; and human activity principles. Students are taught the basic principles, and then must apply them to increasingly complex problems in agriculture.

Technology Education

Harper and McManus (1992) state that if students are to be taught about technology in agriculture, then basic principles of technology must be taught. The authors argue that agricultural mechanics should move toward a technology curriculum more than a science curriculum. In order to prepare students to work in a rapidly changing technology-based industry, students must have a basic understanding of how things work in order to be able to adapt to technological change.

Technology education has evolved over the course of time just as any field of study would. In the early years, there were two distinct schools of thought on what technology education should be. The program initially called manual arts became known in the 1950's and 1960's as industrial arts. Its purpose was to teach students skills that would be useful in life and work, not focusing on specific career goals (McCrory, 1992). The second group advocated a manual training program that was to provide society with a skilled work force.

In early 1980, industrial education leaders came to consensus about future directions for the profession (McCrory, 1992). Major curriculum reform called for four content organizers, namely: (a) construction, (b) manufacturing, (c) communication, (d) transportation. Teachers began to focus on concepts and principles of technological systems as opposed to skills. The technology education curriculum has continued to evolve, technology educators exploring new technological systems models for curriculum improvement.

In early 1990, the American Vocational Association and the International Technological Education Association proposed a new technological systems model, with input, process, and output as the curriculum organizers (McCrory, 1992). In order to implement the new curriculum, technology educators focused on providing in-service training for teachers, and exploring ways to update existing laboratories.

Ryerson (cited in Eighmy, 1995, p. 48) stated that Technology Education is concerned with industry and its organization, personnel, systems, techniques, resources, products, and the social and multicultural impact of technology and industry. Students are involved in nontraditional classroom activities such as problem solving and research and development. There is a heavy emphasis on learning by doing. In becoming technologically literate, students would utilize process skills and experiential classroom activities that encourage personal autonomy and individual control over one's life (Eighmy, 1995).

Objectives of technology education would include: (a) an emphasis on both knowing and doing; (b) applied math, science, and communication concepts; (c) development of higher order thinking skills; (d) providing relevance and application, and; (e) meeting different learning styles (Eighmy, 1995).

Maley (1980) calls for industrial arts education to make a major contribution to society in the form of technology education based upon increasing knowledge of technology and its judicious use. The author formulated the following guidelines for establishing a focus and direction for industrial arts:

1. The program should focus on technological alternatives in dealing with the identifiable problems of mankind.
2. The program should provide insights into and more effective use of leisure time.
3. The program should provide for extensive and effective involvement in community and societal problems.
4. The program should make extensive use of community resources.
5. The substance of the program should promote the development of innovation, problem solving and speculation.
6. The program should be based upon a living-learning involvement with the current and future issues facing mankind.
7. The program should be directed toward the total population and at all levels in education.
8. The program should be directed towards the wise use of technology.
9. The program should be multi-disciplinary in its approach to problems and issues.
10. The program should place considerable stress on the development of the learning processes.

11. The program should be rooted in the human needs of a dynamic, fast-changing society.
12. The program activities, content, and processes should be based upon the learning and growth needs of the individuals served. (pp. 15, 29, 32)

To attempt agricultural mechanization program reform, an understanding of the current status of the curriculum was needed from an agricultural mechanics education/technology education perspective in particular. However, a general understanding of curriculum theory and practice was needed to address the prospect of revisions within the agricultural mechanics curriculum in agricultural education.

Curriculum Theory

Decisions made regarding curriculum, whether consciously or unconsciously, directly influence what content teachers teach, how they teach it, and what students ultimately learn and carry with them. One's definition of what curriculum is certainly guides one's decisions regarding curriculum. In attempting to define curriculum, the researcher found many different definitions of curriculum.

Tyler (1949) stated, "The curriculum is the heart of schooling."

Hass (1983) defined curriculum as:

> The curriculum is all of the experiences that individual learners have in a program of education whose purpose is to achieve broad goals and related specific objectives, which is planned in terms of a framework of theory and research or past and present professional practice (p. 4).

Further, Hass (1983) emphasized that there are five factors that should be included when defining curriculum:

1. Curriculum is a planned program.
2. Guiding the preplanning of curriculum should involve the learners themselves, the school, the instructional group, and the school system; as

they develop planned objectives and consider theories and research concerned with human development, learning, knowledge and cognition, and social forces.

3. The teacher is central in planning of the curriculum, since the teacher often has more influence on what is actually taught than the preplanned curriculum. Teachers should be guided by their knowledge of theories and research in curriculum.
4. For each learner, the actual curriculum is the learner's experiences, past and present.
5. As the curriculum becomes to a greater extent education rather than just schooling, the teacher becomes more important in addressing the uniqueness of each individual learner and the role of the local community. Flexible learning alternatives must be preplanned so that decisions are made in terms of objectives, and criteria of the curriculum.

Hass (1983) described four bases of the curriculum which serve to guide curriculum planning and decision making. They are (a) social forces, (b) human development, (c) the nature of learning, and (d) the nature of knowledge and cognition. Views of human nature such as the rational-economic man, social man, and self-actualizing man help to develop the four bases of curriculum.

Certainly philosophy enters into nearly every curriculum decision that is made. All human behavior is a product of complex patterns of interacting forces; psychological elements come into play; physiological and biochemical processes influence learning, behavior and personality; sociological elements also affect behavior. Therefore a "multi-dimensional" approach to curriculum and instruction planning is necessary (Hass, 1983).

Firth and Kimpston (in Beauchamp, 1975, p. 105) stated, "The curriculum is a vital, moving, complex interaction of people and things in a fluid setting. It encompasses questions to be debated, forces to be rationalized, goals to be illuminated, programs to be activated, and outcomes to be evaluated."

Curriculum also can be defined as the teaching act itself. Sharpes (1988) stated that the curriculum is not a plan, but the plan in action. "The curriculum is not a body of knowledge, but someone knowing what to teach. This implies that curriculum is what the teacher does, and what the teacher knows, and who the teacher is" (p. 11). Further, Sharpes (1988) stated that:

> Curriculum is in the mind of the curriculum transmitter, and can only be learned (in an interactive sense) from the words and actions expressive of such a mind. As is true with many major theories, the one which shows the most favorable promise may be that which appears most simple and yet has appeared most elusive. (p. 19)

Beauchamp (1975), in defining curriculum, presented three ways in which the term curriculum is most widely used:

1. A curriculum consists of a written document, containing many ingredients, which basically is a plan for the education of students during their time at a certain school.
2. A curriculum system in which decisions are made about what will be taught and how.
3. A curriculum is a field of study.

Included in the written curriculum would be proposed learning opportunities for students; a set of intended outcomes; written objectives, activities, instructional materials, and time schedules. Beauchamp also noted that the terms curriculum and instruction are often used interchangeably.

Contemporary curriculum conceptions tended to fall within four major categories. Supporters of each view tended to have differing ideas of what should be taught, to whom, when, and how. The four categories according to McNeil

(1990) were (a) humanistic, (b) social reconstructionist, (c) technological, and (d) academic.

The humanistic curriculum would provide for personally satisfying experiences for each person. This orientation places the student at the center of the curriculum. The social reconstructionist curriculum stresses societal needs over individual interests. The technologists view curriculum development as a technological process for achieving what the policymakers want. The academic view curriculum as the vehicle by which learners are introduced to subject matter disciplines and organized fields of study.

Doll (1992) defined two distinct philosophical views of what the curriculum should be. The "Traditionalists" believe that what was done in the past was done well, therefore we should hold onto it in the future. The "Progressivists" look critically at past actions and practices to see what can be done differently to make learning more meaningful and effective. Traditionalists believe in the superiority of liberal studies, whereas Progressivists consider the liberal and practical arts to have equal value.

Dewey (1938) believed that in order for education to accomplish its ends for both the individual learner and for society, it must be based upon experience. He called for education to be neither "traditionalist" or "progressivist"; that neither of these sets of values and beliefs about education is sufficient unto itself, that both are essential.

Dewey would not have the curriculum start with the facts and truth outside the range of experiences of those taught, rather he would begin from where the learner actually is, building upon his/her experiences. He believed that subject matter should become the tool for understanding and ordering experience.

Bobbitt (in McNeil, 1990, p. 380) stated that education "is essentially a process of unfolding the potential abilities of a population and in particularized relation to the social conditions." Further, "studies are means, not ends" (p. 380).

Perhaps the most complete definition of curriculum that this researcher's review of literature found would be that of Doll (1992): "The curriculum of a school is the formal and informal content and process by which learners gain knowledge and understanding, develop skills, and alter attitudes, appreciations, and values under the auspices of that school" (p. 6). It includes both formal and informal aspects of schooling; the content of what is learned as well as the process; products or outcomes in the form of knowledge, understanding, skills, attitudes, appreciations, and values. The curriculum can be planned or hidden (Doll, 1992).

Curriculum Development

Regardless of the lack of agreement on the exact definition of curriculum, most curriculum theorists did agree that the curriculum is ever-changing. The curriculum cannot remain stationary, because society continues to change. New knowledge replaces old knowledge, and needs to be incorporated into the curriculum. Therefore, curriculum must change to meet the needs of the learners within a dynamic society.

As there were many definitions of curriculum, there were just as many ideas as to how curriculum should be developed.

Tyler (1949) identified four fundamental questions which must be answered when developing any curriculum and plan of instruction:

1. What educational purposes should the school seek to attain?
2. What educational experiences can be provided that are likely to attain these purposes?
3. How can these educational experiences be effectively organized?
4. How can we determine whether these purposes are being attained? (p. 1)

These questions form a logical basis for a curriculum model, stated from the school's viewpoint. The questions can also be viewed from the standpoint of the "student," "society," "subject," or "nation," instead of the "school."

Taba (1962) detailed her own seven step procedure for curriculum development:

1. Diagnosis of needs
2. Formulation of objectives
3. Selection of content
4. Organization of content
5. Selection of learning experiences
6. Organization of learning experiences
7. Determination of what to evaluate and of the ways and means of doing it. (p. 12)

When applying this procedure, the curriculum developer must make clear what viewpoint is being expressed. If from the viewpoint of the student, for example, then the diagnosis would be of student needs. If the developer was looking at curriculum from society's perspective, then the needs of society are being discovered. Ideally, the curriculum is being developed taking into consideration all the viewpoints that need to be considered (student, school, society, nation, world).

The curriculum design developed must identify the elements of the curriculum, state what their relationships are to each other, and identify principles of organization needed for the curriculum. Included within the organizing principles, the design should indicate some sort of scope, sequence, and methods of integration.

In curriculum development, it is important to keep in mind that what the stated or formal curriculum is, may not actually be what is being taught. Curriculum designs must not be so narrowly conceived as to miss what the actual curriculum should be . McNeil (1990) listed five different curricula that operate on different levels:

1. The ideal curriculum - includes curriculum recommendations proposed by groups with special interests or a particular value system, as a means of competing for power within the society.

2. The formal curriculum - includes those proposals that are approved by state and local boards.
3. The perceived curriculum - what the teachers perceive the curriculum to be.
4. The operational curriculum - what actually goes on in the classroom.
5. The experiential curriculum - what students actually derive from and think about the operational curriculum. Each student's background of experience contributes to what the student gets out of the curriculum.

Curriculum Models

If there was any agreement whatsoever in curriculum designing and development, it was that the curriculum is constantly in need of modification (Doll, 1992; Sharpes, 1988). Elements of the curriculum wear out and need to be replaced. New knowledge replaces old knowledge and must be incorporated into the curriculum. Curriculum models are a way of explaining the interacting pieces of the curriculum and its processes, in a model form that can then be applied to various situations.

The search for a grand design for curriculum has been undertaken several times. The Thirty Schools experiment, or commonly called the Eight Year Study, attempted to answer four questions:

1. What should be done within the school?
2. What subject matter should be used?
3. What type of school organization and classroom procedures should be followed?
4. How should results be evaluated?

Another design, the General College Project, focused on four elements necessary for a well balanced curriculum:

1. The philosophy of life and education of the educators.

2. The needs of society and school resources.
3. The needs and interests of pupils.
4. The purpose and outcomes of the curriculum.

These two models were partial designs, they lacked a pattern of relationships among the elements of the design. A comprehensive design shows the interrelationships of its elements, states how learning experiences shall be selected and organized, and illustrates the roles of teachers and other personnel in curriculum planning (Doll, 1992).

The following models are examples of known models that typically would apply to an agricultural mechanization/technology program. The models were examined by the researcher to gain insight into known models of curriculum design within agricultural mechanization education. Taba (1962) stated, "Those who work in curriculum development need to look closely at the path they have been following in order to see more clearly where it is leading, and to chart the possibilities for future ends" (p. v).

Systems approach

The industrial-engineering model, or the systems approach, is a classic, tightly operated mode of designing the curriculum. The interrelatedness of the system, including people, buildings, books, and equipment are designed to function together to bring about change in peoples' behavior (Doll, 1992).

The systems approach is useful in making decisions among alternatives. The process involves gathering criterion information about each alternative, applying "decision rules" that must be considered in the final decision, choosing one alternative, reviewing it, and finally deciding for or against the choice. After the choice has been made, a number of procedures can be followed to determine what the design will entail . One, the Planning, Programming, Budgeting, and Evaluation System (PPBES), projects programs into the future, to determine the effects of the different parts of the system. PPBES is a heavily cost-oriented approach, so useful if budget constraints are a factor.

The critical path method may be used in determining what routes to take in implementing decisions. The Program Evaluation and Review Technique (PERT), developed by the United States Navy and the Lockheed Aircraft Corporation is a critical path method that is effective in sequencing events and generating time lines (Doll, 1992).

Critics of the systems approach find it to be an overly "managed" way of functioning which doesn't encourage original ideas.

Futuristic model

This model responds to the realization that the world of the future will be different from the world of the present, therefore people must be prepared to live in the future. Within the futuristic model there are numerous techniques used to implement the curriculum. McNeil (1990) lists typical phases including:

1. The Multidisciplinary seminar. Professional educators and specialists from outside of education prepare papers and discuss future developments and curriculum planning.
2. Judgement of projected trends. Changes in curriculum are made according to what is projected for the future.
3. Educational acceptance for creating the future. Once social consequences of trends are determined, the schools decide how to respond. Educational objectives attempt to support positive futures and resist negative ones.
4. Scenario writing, whereby writers prepare descriptions of changes in subject matter, learning activities, curriculum organization, methods, and learner outcomes if action is taken as in phase 3.

Other methods used within the futuristic model could include a Strategy Planning Network and the Delphi method. A Strategy Planning Network consists of a group of schools, joined together to analyze changes for which the schools should be planning, to develop a program suitable for all students in the next century.

The Delphi method is used by curriculum makers to obtain a consensus on goals and objectives for the future. A panel of experts is used. Questionnaires are sent to panelists, soliciting their expert opinions on selected areas of concern. In an attempt to gain consensus, additional questionnaires are sent, providing information about all the participants responses to the previous questions. Participants are asked to reconsider their first recommendations and to give their reasons. Usually consensus begins to form and an additional round may be sent out to complete the survey.

The problem with the futuristic model is the same for anyone trying to predict or invent the future. Also, it is difficult to get a broad enough base of participation within and outside school systems, and in understanding the many factors that affect the school curriculum. Often it is difficult to reach a meaningful consensus among participants.

The rational model

Ralph W. Tyler's model consists of four elements (a) objectives, (b) activities, (c) organization of activities, and (d) evaluation. The objectives are to be selected on both philosophical and psychological grounds. The objectives form the base for selecting activities. The activities are organized sequentially and are interrelated. Evaluation is used to determine if the objectives are being attained (Doll, 1992).

Tyler (1949) described the model as having three components, namely input, process, and output.

Critics of the model find Tyler's objectives too simplistic and crude; that the model is too mechanized; and find that it fails to address questions of value (Doll, 1992). Another criticism is that the model tends to be "top-down" in approach, causing the school's goals and objectives to be too narrow, leaving no room for teacher or learner autonomy (McNeil, 1990).

CBE (Competency Based Education)

Spady (1977) defined Competency Based Education (CBE) as,

> A data-based, adaptive, performance-oriented set of integrated processes that facilitate, measure, record and certify within the context of flexible time parameters the demonstration of known, explicitly stated and agreed upon learning outcomes that reflect successful functioning in life roles. (p. 9)

CBE provides for the individual learner by utilizing programs of competencies agreed upon by the instructor and learner; flexible time parameters; a variety of learning activities and experiences; validation of mastery learning; and program adaptability based upon the individual student's performance.

Critics of CBE point out that to implement CBE takes large amounts of planning time and resources. Additionally, concerns with testing and test standards have been raised (Schnellert, 1993).

OBE (Outcome Based Education)

A definition of Outcome Based Education (OBE) would include that it is a learner-centered, results-oriented system based upon the belief that all individuals can learn (Minnesota State Department of Education, 1991). Further, it is a program of designing, developing, delivering and documenting instruction based upon its intended outcomes. Within the system, what is to be learned is clearly identified; learners demonstrate achievement to progress, therefore time is not a constraint; and instruction is modified for each individual learner as needed.

Critics of OBE (Schnellert, 1993) maintain that OBE requires too much time, that teachers are already stretched to their limits. Further, that OBE is too concerned with results, rather than the process of attaining the outcomes. A final criticism comes from those opposed to non-academic outcomes often included in curricular outcomes. Parents want a say in what is being taught in their schools, including values (Schnellert, 1993).

Vocational/Technological Models

The vocational or training model

"Training" models in general imply narrower purposes than do educational models (McNeil, 1990). Students' competence in an occupation is the usual objective. The two functions of the training model according to McNeil include determining occupational targets and determining the objectives for training programs.

The first function, determining occupational targets, utilizes existing studies or plans that project manpower needs. The second, determining objectives for training programs, involves utilizing job descriptions and task analysis to enhance the relevancy of the training program to the job to be performed.

Critics of the vocational model maintain that the model is associated with "presentism," therefore it focuses on the current situation rather than on a likely future condition (McNeil, 1990). Another problem with the model is that many aspects of jobs are uncertain, therefore the model is unable to prepare workers for dealing with changing circumstances, and tends to perpetuate the status quo.

Technical systems model

A variation of the systems approach, this model is used in technology education. The system includes input, process, and output as the major curriculum organizers. Inputs would include people, tools and machines, information, materials, energy, capital, and time. Processes would involve biotechnology, communication, production, and transportation. Outcomes would be solutions to human needs and wants. The main instructional strategy for implementing the model would be a problem-solving approach (McCrory, 1992).

Authentic assessment

Stemming from discontent with conventional testing procedures and results, educators look to other means of assessing student learning. Authentic assessment includes alternative assessments that are used to measure student achievement. They may include portfolios, performance assessment and product assessment. Wolansky (1985) stated that authentic assessment involves the writing of performance objectives, selecting content, determining emphasis and identifying crucial tasks to be learned.

Johnson (1993) observed that many professionals have felt that assessment in many vocational/technology classrooms closely resembles authentic assessment. Students complete assignments using problem-solving skills and hands-on experience with tools, machines and materials. Instructors observe and assist students throughout the process and can continually assess student performance.

Psychomotor assessment

Largely used by vocational/technology educators, psychomotor assessment involves performance, process or sensory-motor skills measurement. Students are evaluated under controlled conditions to test performance aspects such as rate of work, quality or precision of work, and procedure used to accomplish the task, compared with predetermined standards (Schnellert, 1993).

An added benefit of psychomotor tests is that they give students the opportunity to demonstrate their capabilities, which builds self-confidence and practice in self-evaluation.

Tech prep

The tech prep model provides an alternative to the typical college prep course of study provided in secondary educational institutions. Tech prep prepares secondary students for employment opportunities, and prepares students for continuing education at an associate degree level.

Schnellert (1993) lists the goals of tech prep as the following:

1. To provide purposeful educational program alternatives for students who are not well served by existing secondary and post-secondary curricula.
2. To prepare students for gainful employment upon high school graduation as well as later in life.
3. To prepare students for education beyond high school, especially in Associate of Applied Science (AAS) degree programs, but also in apprenticeships, on-the-job training, cooperative education and continuing education.
4. To attract significantly more students into careers in health, business, technology and other areas that require less than baccalaureate preparation.
5. To facilitate the movement of students from high school to college through close articulated linkages with post-secondary curricula.
6. To strengthen secondary vocational programs through the increased relevant academic content.
7. To utilize instructional methods in traditional academic areas that will encourage success in students representing a wide range of learning styles and abilities.
8. To maximize flexibility in choices of educational and career paths, and to allow students to alter paths with minimum penalty.
9. To strengthen associate degree programs with more advanced content and a greater focus on student learning styles.
10. To stimulate and apply leverage to create changes in educational practices that are needed in order to respond to changes in society, especially those brought about by technology. (pp. 53, 55)

The Carl D. Perkins Vocational and Applied Technology Education Act was passed in 1990, and began an educational reform movement. The act was created by the United States Congress to make available funds for the establishment of tech prep programs for students in the last two years of high school and the first two years of post secondary education. The programs are characterized by the integration of basic and applied studies, cooperation among teachers in different subject areas, involvement of employers, and articulation of course content and sequence within and between educational institutions at various levels (Osborne, 1994).

Whaley, Lucero, and Rask (1993) stated that Tech prep assists students in moving more rapidly and with a higher degree of technical competence into the workforce or to an advanced educational level. For students that go on to post-secondary institutions, their increased levels of enthusiasm, competence and ability make the transition to post-secondary education more successful.

The Technological Method Model

A conceptual framework for technology education is discussed by Savage and Sterry (1990a, b), utilizing the Technological Method Model. The model can be used at the personal, organizational, institutional, or global level. It is the model for "doing" technology. The format of the model consists of (a) human needs and wants, that lead to (b) the identification of problems and opportunities, that must be addressed using (c) resources and (d) technological knowledge, through (e) technological processes, to reach (f) evaluable (evaluation), (g) solutions that have impacts.

Practical implications for the use of the model include:

1. Laboratory activities should be an integral part of any curriculum addressing technology. By "doing" technology, students will come to understand the nature of the enterprise, its methodology, and guiding principles.
2. Technological knowledge must be integrated with laboratory activities.
3. Technological objects, artifacts, and systems are created within specific environments.
4. Technology should be distinguished from science by making very clear the differing purposes each serves. Technology is oriented toward creating a pragmatic object or system to meet a specific human need. Science aims at understanding the natural world, toward explaining natural phenomena, and developing theoretical knowledge.

5. Finally, the role of human will in the design and creation of technological objects should be acknowledged. (Savage & Sterry, 1990b, p. 8)

Vocational Curriculum Development Model for Agriculture

This model recognizes four levels of vocational development: (a) operational, (b) skilled, (c) technical, and (d) professional. To illustrate with an example from agricultural mechanics, an operator runs a lawn tractor, a skilled employee repairs it, a technician builds it and a professional designs it (Curtis, 1978).

According to Curtis, the four-level job classification scheme has important implications for curriculum design and instructional materials for the following reasons: (a) adaptations to meet the differing interests and ability levels of students are required; (b) the broader the range of operational tasks learned by students, the greater their employability; and (c) the design of instructional materials to include operational, skilled, and technical levels can improve upward mobility of students.

Curriculum must be designed to promote horizontal/vertical occupational development of students as their interests and abilities allow. An individualized method of instruction is a necessary component in this concept. The curriculum model has two central objectives: (a) it is designed in respect to the world of work rather than a subject matter approach, which spans all levels of occupational development within a single unit; and (b) it is geared to the interests and capabilities of the students (Curtis, 1978).

The model requires appropriate instructional materials for each occupational level. Current curriculum materials in agricultural education may not readily adapt to the model (Curtis, 1978).

Related Research

In reviewing related studies in the field of agricultural mechanics within agricultural education, the researcher found that there was a lack of research relating to agricultural mechanics instruction.

Hill, Harper, and Symons (1988) conducted an analysis of agricultural mechanics research reported in three principal journals in the 1980's. The journals were: Applied Engineering in Agriculture, The Journal of Agricultural Mechanization, and The Journal of the American Association of Teacher Educators in Agriculture. Information was collected on articles published in the three journals from 1980 through 1987. Of 410 articles, 182 were directly related to agricultural mechanics. These articles were then broken down by topic area and the number of articles by topic area were recorded. Topical areas and the number of articles under each were as follows: Mechanization/Engineering, 141; Learning/ Methodology, 13; Curriculum/Content, 12; Safety, 7; Employment, 3; Economics/ Engineering, 2; Safety/Engineering, 2; FFA Contest, 1; Human Factors, 1.

In reviewing their findings, the authors felt that these journals provide an outlet for relevant research in agricultural mechanics, yet engineering dominates the research submitted. They felt there is a lack of a broad base of research in the field of agricultural mechanics education. Because the progress and evolution of any field of study is dependent upon its theory and research base, the authors felt that the development of a systematic research program in agricultural mechanics education was greatly needed.

Of the studies that were found, several (Laird, 1994; Burke & Hillison, 1988; Cox & Zubrick, 1986) sought to determine the value and content of agricultural mechanics instruction.

Burke and Hillison (1988) conducted a study to determine teacher perceptions of the value and need for agricultural mechanization content in the Virginia Tech agricultural education undergraduate degree program. A descriptive study was undertaken involving 321 teachers of vocational agriculture in Virginia.

The instrument used collected specific demographic information and had vocational agriculture teachers rate the value of 39 courses, taken in their baccalaureate degree program. Open-ended questions to gather data regarding teacher preferences for more or less coursework in certain areas were used.

Teachers indicated that agricultural mechanics courses were the most valuable undergraduate courses that helped them in their job as an agriculture education teacher. The top ten courses valued the most were a mix of technical, agriculture education, and communications. Least valuable were courses in the arts and sciences. Respondents indicated a preference for additional technical and agricultural education courses in their undergraduate degree programs (Burke & Hillison, 1988).

Another study conducted by Cox and Zubrick (1986) helped to gain an understanding of the perceived importance of agricultural mechanics within agricultural education. Among 56 Arizona vocational agriculture teachers and 44 secondary school principals, both respondent groups felt that providing instruction in agricultural mechanics was one of the most vital activities that teachers could engage in (Cox & Zubrick, 1986). According to Laird (1994) a national study of vocational agriculture teachers conducted by Kotrlik and Drueckhammer in 1987, provided similar findings.

Laird (1994) also discussed the importance of agricultural mechanics in non-traditional areas. A study done by Hansen and Oades (cited by Laird, 1994, p. 8 from Ford, 1984) of a horticulture program in the state of Oregon concluded that 20 to 25 percent of the instructional units in the total two-year program should consist of agricultural mechanics taught in a shop setting.

In 1980, Heimgartner (in Laird, 1994, p. 10) conducted a survey of agricultural education teachers in five northwestern states to determine their perceptions of the importance of specific units in agricultural mechanics in the agricultural education curriculum, and to determine the level of knowledge the teachers possessed in those agricultural mechanics units.

It was found that the teachers spent more of their time in the instructional area of agricultural mechanics than in any other area. The largest percentage of the instructors' preparation in agricultural mechanics came from previous experiences and farm backgrounds, with college experience accounting for the next largest percentage. Previous experience in agricultural industry and previous vocational agriculture training also contributed to the respondents' preparation in agricultural mechanics. Studies found concerning specific content within the agricultural mechanics curriculum in agricultural education included those by Miller and Gliem (1994) and Schlautman and Foster (1991).

In conducting a study regarding the Nebraska secondary agricultural mechanics curriculum within agricultural education, Schlautman and Foster (1991) sought to determine what agricultural mechanics units of instruction should be included in the curriculum and to what extent. The study additionally sought to determine the percentage of the total secondary agricultural education program that should be devoted to teaching agricultural mechanics in the 1990's.

Three groups compared in the study were (a) secondary agricultural educators, (b) farm operators, and (c) agribusiness managers. Of the instructional units included in the study, all 47 were determined to be important enough for inclusion in the program at some level of instruction. There were differences between the three groups as to the perceived importance of certain units. All three groups agreed that about 30 percent of the agricultural education curriculum should be devoted to the teaching of agricultural mechanics. The authors' findings indicated that technology areas such as robotics, solid state controls, sensing devices, and onboard computers should be included in the agricultural mechanics curriculum for the 1990's.

Miller and Gliem (1994) examined the variance in the mathematical problem-solving ability of pre-service agricultural education teachers. They found that pre-service agricultural education instructors were lacking in ability to apply basic mathematical skills to agricultural problems. Recommendations from the authors included that mathematical problem-solving be incorporated into the technical agriculture courses taken by undergraduates in agricultural education.

In-service education needs of agricultural mechanics instructors within agricultural education were studied by both Newman and Johnson (1993) and Shinn (1995). Newman and Johnson (1993) conducted a study to identify and assess the in-service education needs of teachers who taught pilot agriscience courses in Mississippi. The study design was a descriptive survey with a population of 39 teachers. Teachers rated the importance of the units taught in the pilot courses, as well as their competence in teaching the subject matter in the units. Findings indicated that there were areas where the teachers felt they lacked the competence to teach the subject matter as effectively as they would like. The areas the teachers perceived themselves less competent in included: computers, biotechnology, mechanical technology, entomology, environmental science, and aquaculture. The authors indicated that the undergraduate curriculum should be restructured to provide better preparation in these subject areas. In-service education and more instructional materials are also needed to assist the teachers in these subject areas.

Shinn (1995) examined curricular issues in the secondary school agricultural mechanics program area using a panel of "friendly critics" of the current secondary agricultural mechanics program. The Delphi technique was utilized to elicit and refine the experts' opinions. The "friendly critics" selected were representatives of faculty and administrators in agricultural education, agricultural engineering, colleges of agriculture, and state departments of education. Findings were used to develop a consensus document providing focus and direction to the curriculum in agricultural mechanics (Shinn, 1995).

The specific objectives in this study were to identify:

1. the purposes of the ideal secondary curriculum that includes agricultural mechanics,
2. the educational experiences necessary to accomplish the desired purposes of the secondary curriculum,

3. how learning experiences can be organized for effective instruction,
4. how the effectiveness of learning experiences can be evaluated,
5. the perceived strengths and limitations of agricultural mechanics as it is now organized,
6. the strategies for the preparation of the secondary teacher in agricultural mechanics,
7. in-service and professional development for teachers in agricultural mechanics. (pp. 17-18)

Findings of the "expert jury" in Shinn's (1995) study recommended three broad purposes for the curriculum: (a) developing positive attitudes about safety and quality of work, (b) developing knowledge and comprehension of principles that govern physical science, and (c) developing useful application skills (p. 20).

Educational experiences recommended included: (a) integrating teaching methods that foster knowledge and problem-solving in holistic systems, (b) using project methods that employ current technology to address real-world problems, and (c) facilitating actual work experience (p. 21).

Organization of learning experiences within an effective curriculum consisted of: (a) insuring all experiences are safe; (b) simultaneously coupling practical examples with theory in experiential learning settings; (c) selecting sequential experiences that apply to broad settings and applications; and (d) organizing spiral experiences that foster technical knowledge, entrepreneurship, and cooperative learning (p. 22).

In determining how the effectiveness of learning experiences can be evaluated, three broad categories of evaluation were recommended by the jury: (a) establishing clear and measurable outcomes, (b) insuring evaluation be systemic throughout the curriculum, and (c) using authentic assessment and performance primary evidence (p. 23).

Current strengths of the agricultural mechanics program were identified as: (a) continuing active learning by doing, and (b) developing positive self-esteem among all students, especially under-achievers (p. 24).

Limitations of agricultural mechanics as it is now organized were listed as: (a) poor housekeeping creates negative image, (b) failing to address higher-level technology skills, (c) using projects that are not appropriate, (d) failing to incorporate electronics and other high-tech systems, and (e) teacher background and preparation are often a limiting factor (p. 25).

Perceived preparation needs for secondary teachers of agricultural mechanics programs included: (a) problem-solving approaches should be integrated throughout the total curriculum, (b) industry-sponsored programs should be used to develop practical experience, and (c) recognize that agricultural engineering departments that traditionally taught service courses must now respond to a different set of needs and opportunities (p. 26).

In-service and professional development strategies for secondary teachers of agricultural mechanics programs should include: (a) recognizing a new set of rules for teaching agricultural mechanics; (b) insuring assessment is based on teacher needs; (c) providing access to teaching materials that integrate science, mathematics, and technology using teamwork and modern equipment; and (d) developing strong collaboration among teachers, industry, and university faculty (p. 27).

Shinn (1995) concluded:

> The perception was that the current programs use active learning methods and builds self-esteem among students. However, the program has an image of being dirty and low-tech. More often, projects are not appropriate for today's needs and the teacher is often viewed as a limiting factor in high quality programs. Preparation of teachers must develop stronger collaboration with industry, develop problem-solving skills, and seek courses from non-traditional sources. Teachers must be active learners that continually re-assess needs and access new technology through integration and collaboration. (p. 28)

Shinn (1995) called for further research to assess opinions of industry, program completers, and current students to assist in redesigning the curriculum.

Laird (1994) conducted a study to assess the status of the agricultural mechanization curriculum as perceived by secondary agricultural educators in the United States. The study sought to determine the current instructional emphasis of secondary agricultural mechanics programs in the United States, their strengths and weaknesses, and future directions for secondary agricultural mechanics programs in the United States.

Results of Laird's (1994) study indicated that the instructional units being taught at the greatest depth included (a) shop and tool safety, (b) safety clothing and protective devices, (c) cooperation and teamwork and (d) arc welding. Instructional units taught with the least emphasis included (a) plastic welding, (b) robotics, (c) transmissions and (d) drive trains.

Instructional units perceived as being most important for the future included (a) shop and tool safety, (b) safety clothing and protective devices and (c) chemical handling and storage. Least important instructional units for the future included (a) sheet metalworking, (b) transmissions and (c) metal machining.

Agricultural mechanics program factors perceived as being the most adequate included (a) personal interest in the subject, (b) teaching methods used and (c) personal knowledge or skills in the subject matter. Program factors thought to be the least adequate were (a) in-service programs, (b) budget and (c) availability of teaching time.

The study found that the most experienced teachers (21 years of experience or more) taught the agricultural mechanics instructional areas with more depth than less experienced teachers, and felt that future importance of the instructional areas was more significant than did the less experienced teachers.

Frequency of attendance at agricultural mechanics in-service workshops was a strong indicator of the teacher's current teaching depth and perceived future importance of the instructional area.

Laird's (1994) recommendations included:

1. Continue to include agricultural mechanics in the secondary agricultural education curriculum.
2. Coordination of agricultural mechanics in-service programs among state Departments of Education, university and college faculty, and secondary agricultural educators.
3. Develop instructional materials for new areas such as (a) computers, (b) physics and mathematical applications, (c) energy conservation, (d) waste handling and (e) environmental control.
4. Develop the curriculum to include scientific experimentation and encourage teamwork and problem-solving skills.
5. Study the effects of changes in teacher certification on agricultural mechanics programs.
6. Solicit student perceptions of the agricultural mechanics curriculum and how they feel it can best meet their needs.
7. Study programs currently using science-based curriculum in agricultural mechanics.

Eighmy (1995) conducted a study to develop strategies for agricultural technology curriculum design in vocational education. Additionally, the study sought to develop strategies for meeting the needs of students enrolled in agricultural teacher preparation programs and in-service education classes.

A three round Delphi study was then conducted, using teacher educators as the expert panelists. It was a regional study, the purpose of which was to clarify and articulate what the relationship between Industrial Technology Education/ Technology Education and the agricultural mechanics component of Agricultural Education should be in the future. Further, the study tried to determine what changes in agricultural mechanics should be considered to meet the future needs of students in secondary programs, teacher preparation programs and in-service teacher education programs.

Results of this Delphi study indicated that:

1. There is a need for a national, regional, and state level vision and program change.
2. Guiding principles and practices were developed for future secondary agricultural mechanics curricula.
3. Strong support was given for integration of math and science into the agricultural mechanics curriculum.
4. The role of teacher preparation programs should be re-evaluated, programs should not eliminate instruction in agricultural mechanics, and guiding principles and practices were developed for teacher preparation programs in agricultural mechanization.
5. Leadership is needed at all levels of agricultural education in determining the future role of the technology-related component in agricultural education.
6. Guiding statements were supported addressing future in-service needs of professional practitioners in agricultural education.
7. Strategies for the delivery of technology-related agricultural education curriculum were developed.

Eighmy's recommendations for further study indicated that more research is needed in the area of the technology-related component of agricultural mechanics; successful strategies for curriculum integration that include agricultural mechanics need to be identified; the future structure and content of agricultural mechanics instruction needs to be addressed at a national level; and a national "vision" for the future role of agricultural mechanics should be addressed.

Summary

The review of literature provided a basis for the researcher from which to build and affirmed the need for the study.

The purpose of the study was to determine the perceptions of secondary school agricultural educators regarding the role of agricultural mechanics in the secondary agricultural education curriculum, and to provide direction for revision and enrichment of the curriculum.

A brief overview of the history of Agricultural Education was developed to gain a philosophical understanding of the discipline, as well as to identify the issues affecting curriculum and instruction in agricultural mechanics from the past to the present.

Education in agriculture was offered in some schools in the early 1800's. The Morrill Act of 1862 paved the way for the establishment of a more formal agricultural education, with the endowment, support and maintenance of at least one agricultural and mechanical arts college in each state.

In 1917, with the passage of the Smith-Hughes Act and resultant federal funding, "vocational agriculture" more or less replaced general agriculture in the schools.

Instruction in agricultural mechanics has evolved over the course of time, from preparing young people to not only return to the farm, but pursue other off-farm agricultural occupations. Agricultural power, machinery and equipment, electrification, soil and water management, agricultural buildings, and basic shop skills were all a part of the curriculum.

In 1985, a major study was undertaken to address the concerns about the declining profitability and international competitiveness of American agriculture, along with concerns about agricultural education programs. The Committee on Agricultural Education in Secondary Schools, established by the National Research Council, found that many vocational agriculture programs were outdated and were in need of being revised.

The changes within agricultural education have been towards agri-science; in agricultural mechanics, as applications of physical science and math concepts and principles. Osborne (1992) called for a shift from a product focus to a process focus within the curriculum. Slocombe (1986) stated that the agricultural mechanics curriculum must emphasize communications, management, science and technology.

It was felt by some (Harper & McManus, 1992) that if students are to be taught about technology in agriculture, then the curriculum should be more technology-based than science-based. Technology education utilizes learning by doing; application of math, science, and communication concepts; development of higher order thinking skills; and meeting different learning styles. There appeared to be a fair amount of overlapping of the attributes of technology education and agricultural mechanics education.

Curriculum theory was studied to gain insight into what a curriculum entails. The most complete definition of curriculum was found to be that of Doll (1992). The curriculum of a school was said to be the formal and informal content and process by which the learners acquire knowledge and develop understanding, skills, and values.

Methods of developing a curriculum were found to be many and varied. The works of Taba (1962) and Tyler (1949) were both studied. A curriculum design must identify the elements of the curriculum, state what their relationships are to each other, and identify principles of organization needed for the curriculum. In curriculum design it is important to keep in mind that what the stated or formal curriculum is, may not actually be what is being taught.

Curriculum models were studied to determine what approaches to design had been implemented, and to generate ideas for a new model for curriculum in agricultural mechanics within agricultural education. The models examined included: (a) the Systems Approach, (b) Futuristic Model, (c) Rational Model, (d) Competency Based Education (CBE), (e) Outcome Based Education (OBE), (f)

Vocational or Training Model, (g) Technical Systems Model, (h) Authentic Assessment, (i) Psychomotor Assessment, (j) Tech Prep, (k) Technological Method Model, and (l) Vocational Curriculum Development Model for Agriculture.

Clearly, all curriculum models may contribute to a derived model. The researcher attempted to incorporate those aspects of the literature review that would help in constructing the proposed model for agricultural mechanics within agricultural education.

In reviewing related studies, the researcher found that there was a lack of research relating to agricultural mechanics instruction within agricultural education.

Several of the studies found (Burke & Hillison, 1988; Cox & Zubrick, 1986; Laird, 1994) sought to determine the value and content of agricultural mechanization instruction. Secondary teachers related that agricultural mechanics courses in their teacher preparation program were some of the most valuable, and teachers indicated the need for more of them. Both teachers and administrators felt that providing instruction in agricultural mechanics was one of the most vital activities that teachers could engage in. In-service education and more instructional materials were called for to assist teachers that were weak in agricultural mechanics.

Recommendations for curricular reform came from three studies in particular. Shinn's (1995) study suggested the following broad purposes for the curriculum: (a) to develop positive attitudes about safety and quality of work, (b) to develop knowledge and comprehension of physical science principles, and (c) to develop useful application skills.

Laird's (1994) study concluded that the curriculum should be revised to include scientific experimentation, teamwork, and problem-solving skills. Instructional materials need to be developed and in-service educational programs implemented as part of the revision process.

Eighmy's (1995) study sought to develop strategies for agricultural technology curriculum design in vocational education. Additionally, the study offered strategies to meet the needs of students in agricultural teacher preparation programs and in-service education programs.

Recommendations from the Eighmy (1995) study included: (a) strategies for curriculum integration are needed, (b) a national "vision" and direction is needed for agricultural mechanics education, and (c) further research is needed in the field of the technology-related component of agricultural mechanics.

The researcher found that the literature review clearly supported the need for further research in agricultural mechanics instruction within agricultural education. Additionally, the literature review demonstrated the need for direction and revision of the agricultural mechanization curriculum.

CHAPTER III. METHODS

The purpose of this study was to determine the perceptions of secondary school agricultural educators regarding the role of agricultural mechanization in the agricultural education curriculum in secondary schools throughout the Central Region of the United States. Specific research objectives of the study were:

1. Identify perceptions held by secondary agricultural education teachers regarding selected concepts in agricultural mechanization education.
2. Determine instructional areas in agricultural mechanization currently being delivered in secondary agricultural education programs.
3. Identify the degree to which instructional areas in agricultural mechanization could be expanded in future agricultural education programs.
4. Identify selected demographic data of secondary school teachers of agriculture.
5. Design a practical curriculum model for development of agricultural mechanization in agricultural education programs.

This chapter will examine the methods and procedures used in the execution of this study. Specifically, research design, population and sampling procedures, development of survey instrument, data collection, analysis of data, and limitations and assumptions of the study are presented on the following pages.

Research Design

This study was conducted using the descriptive survey method. Descriptive research describes and interprets what is. It is concerned with conditions or relationships that exist; practices that prevail; beliefs, points of view, or attitudes that are held. It involves processes that are going on; effects that are being felt; or trends that are developing (Ary, Jacobs, & Razavieh, 1990).

Descriptive research is designed to obtain information concerning the current status of a phenomena; to determine the nature of a situation as it exists at the time of the study.

Descriptive studies have significantly increased knowledge about what happens in education, producing statistical information about aspects of education that interest policy-makers and educators.

Researchers must first generate an accurate description of an educational phenomenon as it exists, to then be able to explain or change it.

Population And Sampling Procedures

The target population of this study consisted of all secondary agricultural education programs in the twelve states within the Central Region of the United States. The twelve states included in this region were: Ohio, Illinois, Minnesota, Wisconsin, Missouri, Iowa, Indiana, Kansas, Nebraska, Michigan, North Dakota and South Dakota.

The 1995 Agricultural Educators Directory (Henry, 1995) was used to identify the State Agricultural Education Departments in each state. Every state provided the researcher with a current mailing list which was used to determine the number of programs by state. The total population of secondary agricultural education programs was 2,465. It was determined that the necessary sample size was 335 teachers of agriculture (Krejcic & Morgan, 1970).

Based upon the unequal population size among the states, a stratified, proportional random sample was developed to establish equal representation of the total population.

The random number generator in SPSS/PC+ was utilized to determine sample selection by state.

Table 1 indicates how many secondary agricultural education programs there were in each of the twelve states within the Central States Region. The table also illustrates each state's percentage of the total population, and the sample for that state. Ohio had the most programs with 363, 14.63% of the total population, resulting in a sample of 49. South Dakota had the least programs with 81 total, 3.29% of the total population, and a sample size of 11.

Table 1. Total programs, percentage and sample size by state

State	Programs	Percentage	Sample size
Ohio	363	14.63	49
Illinois	307	12.45	42
Minnesota	263	10.67	36
Wisconsin	260	10.55	35
Missouri	257	10.43	35
Iowa	239	9.69	32
Indiana	198	8.03	27
Kansas	158	6.41	21
Nebraska	131	5.31	18
Michigan	123	4.99	17
North Dakota	85	3.45	12
South Dakota	81	3.29	11
TOTAL	2465	100.00	335

Development of Survey Instrument

A mailed questionnaire was developed to collect the data for the study. Questionnaire content and design were determined using the researcher's background, a review of related studies (Eighmy, 1995; Laird, 1994; Shinn, 1995), and consultation with a panel of experts consisting of Iowa State University faculty and graduate students knowledgeable in both Agricultural Education and Agricultural Mechanization.

The questionnaire consisted of three parts. Part I was designed to determine specific perceptions of respondents regarding the role of agricultural mechanization in the secondary agricultural education curriculum. The researcher developed the questions based upon issues identified in the literature review. This information was to assist in the development of the curriculum model in agricultural mechanization. A five point Likert-type scale was used where 1 indicated "strongly disagree," 2 indicated "disagree," 3 indicated "neutral," 4 indicated "agree," and 5 indicated "strongly agree."

Part II of the questionnaire consisted of 32 instructional areas in agricultural mechanization. Respondents were asked if they currently taught in that area, circling either a "Y" for a yes response or a "N" for a no response. Respondents also were asked to rate the degree of expansion they would consider in that instructional area, given appropriate in-service education and instructional materials. The rating scale ranged from a 1 which indicated "no expansion," 2 indicated "low expansion," 3 indicated "moderate expansion," 4 indicated "high expansion," and 5 indicated "very high expansion." This information was needed to meet study objectives two and three and to form the basis from which to develop a model for curriculum development. There must be an understanding of the current situation in order to develop a plan for reform.

Demographic questions were asked to be better able to understand the research findings and develop a profile of the respondents. Part III consisted of eight demographic questions which included: the number of teachers in their program; years of experience; educational level; age; occupational area focus of their program; number of students; instructional facilities; and if adult education programs in agricultural mechanics were presently being conducted.

Data Collection

A copy of the questionnaire, the cover letter, the purpose, objectives, and rationale for the study were submitted to the university human subjects committee for approval on February 27, 1996. The study and questionnaire were approved by the committee on March 6, 1996. A copy of the approval form for human subjects is in Appendix A.

The questionnaire, cover letter and self-addressed stamped envelope were mailed to 20 Iowa secondary agricultural educators on March 27, 1996. The cover letter explained the need to pilot-test the instrument. Instructors were asked to complete the questionnaire and provide input concerning the content of the instrument as well as comments about the length, whether or not it was understandable, etc. Eleven teachers returned the survey. Their responses and suggestions were used to revise the instrument's format and content.

The cover letter, revised questionnaire, and a self-addressed stamped envelope were mailed out to the prospective respondents on April 11, 1996. A copy of the cover letter and questionnaire are in Appendix B. Instruments were coded on the top right hand corner to track non-respondents.

A postcard reminder was mailed on April 29, 1996, to non-respondents as of that date (see Appendix B).

On May 10, 1996, a follow-up letter and questionnaire were mailed to all non-respondents.

Cover letter content and format of all three mailings were devised from <u>Mail and telephone surveys: The total design method</u> (Dillman, 1978). Responses were accepted through May 24, 1996; 221 instruments had been returned. A breakdown of responses by state is included in Table 2.

Table 2. Response rate by state

State	Invited sample	Responding sample	Data producing sample	Percentage
Ohio	49	30	28	57.00
Illinois	42	26	25	60.00
Minnesota	36	21	21	58.00
Wisconsin	35	25	24	69.00
Missouri	35	26	26	74.00
Iowa	32	24	24	75.00
Indiana	27	19	18	67.00
Kansas	21	11	11	52.00
Nebraska	18	15	15	83.00
Michigan	17	10	10	59.00
North Dakota	12	8	8	67.00
South Dakota	11	6	6	55.00
TOTAL	335	221	216	65.00

Responses were accepted through May 24, 1996. Of the 221 responses received by May 24, 1996, five were unusable; one requested not to participate due to lack of time and four had no agricultural programs. This established the response rate of 65 percent. During the last week of May and the first week of June, phone interviews were conducted with ten percent of the nonrespondents by state, thus maintaining the proportional consistency. Ohio, Illinois, Minnesota and Wisconsin required contacting two nonrespondents whereas the other eight states required only one nonrespondent contact from each state. The total number of nonrespondents contacted was 16. All 16 were randomly selected within their respective states. Mean scores were compared by a t-test on the perception questions, instructional areas currently taught and the degree of expansion they would consider.

There were no significant differences at the .05 level found in either the perception questions or instructional areas currently taught, thus allowing the researcher to generalize the findings to the research population. However, in the degree of expansion category, five instructional areas were found to be significantly different. The areas included Alternative Power Systems, Buildings and Structures, Climate Controlled Facilities, Surveying, and Woodworking (see Appendix D for t-test results). Results should be interpreted with caution in these five instructional areas.

Analysis of Data

Data was transferred from individual questionnaires to the Excel spreadsheet program. All missing data were entered as 99 into the spreadsheet.

Statistical analysis was used to check for coding errors within the data. The data were then transferred to the statistical package SPSS/PC+ 6.0 for analysis.

The following statistical procedures were used to analyze the data: frequencies, means, standard deviations, and t-tests.

Assumptions of the Study

The following assumptions were made in this study:

1. The data reflect the true opinions of the respondents.
2. The perceptions of the respondents will yield useful and valid information.
3. Significant factors which relate to the problem were not overlooked.
4. The design, data collection and synthesis of the data could be executed free of personal bias.

5. The researcher would be able to synthesize the data and develop the findings in a way which would provide a framework for improved programs in agricultural mechanization within agricultural education.

Limitations of the Study

The limitations of the study were as follows:

1. The study has implications to agricultural mechanization education programs in the central region. The results are somewhat limiting in that a sample of the non-respondents differed slightly on selected items from that information gathered from the respondents.
2. Results were obtained from a set of responses to a structured questionnaire.

CHAPTER IV. FINDINGS

In this chapter, analysis of data and findings of the study are presented in the same order as the stated objectives. The purpose of this study was to determine the perceptions of secondary school agricultural educators regarding the role of agricultural mechanization in the agricultural education curriculum in secondary schools throughout the Central Region of the United States. Specific objectives included:

1. Identify perceptions held by secondary school teachers regarding selected concepts in agricultural mechanization education.
2. Determine instructional areas in agricultural mechanization currently being delivered in secondary agricultural education programs.
3. Identify the degree to which instructional areas in agricultural mechanization could be expanded in future agricultural education programs.
4. Identify selected demographic data of secondary school teachers of agriculture.
5. Design a practical curriculum model for development of agricultural mechanization in agricultural education programs.

This chapter presents the findings of the statistical analysis of this study. Specific sections include: (a) demographic information, (b) perceptions of agricultural educators, (c) instructional areas taught, (d) degree of expansion within instructional areas, (e) synthesis of written comments, and (f) summary.

Demographic Information

Descriptive information about the respondents is provided in Tables 3-10. Respondents were asked to fill in the blank or check the appropriate answers in the demographic data section of the questionnaire.

Teachers per program

Table 3 indicates how many programs were single teacher programs (183). Of the multiple teacher programs, 22 programs had two instructors, five programs had three instructors, and five programs had five or more instructors.

Table 3. Frequency and percentage distribution of respondents by the number of teachers per program

Teachers per program	Frequency	Percent
Single teacher	183	85.1
Two teachers	22	10.2
Three teachers	5	2.3
Five or more teachers	5	2.3

Years of experience teaching agricultural education

As can be observed in Table 4, the highest percentage of teachers (22%) had less than six years of teaching experience. Respondents with six to ten years of teaching experience made up the second largest group with 20.1%. The smallest group was composed of those with more than 30 years experience teaching at 5.6%. The average years of teaching experience was 14.28. The range of years of teaching experience was one to 39 years of experience.

Table 4. Frequency and percentage distribution of respondents by years of teaching experience in agricultural education

Years of experience	Frequency	Percent
Less than 6	47	22.0
6 - 10	43	20.1
11 - 15	32	15.0
16 - 20	38	17.8
21 - 25	22	10.3
26 - 30	20	9.3
More than 30	12	5.6
Mean 14.3		

Highest level of education attained

Table 5 provides information on academic qualifications of respondents indicating that 60.2% of the respondents had obtained a bachelor's degree, and 39.8% a master's degree.

Table 5. Frequency and percentage distribution of respondents by level of education attained

Highest degree obtained	Frequency	Percent
Bachelor's	130	60.2
Master's	86	39.8

Age

Table 6 indicates that 36 (17.3%) of the respondents were less than 30 years old. Sixty-seven (32.2%) respondents were between 30 and 39 years and 67 (32.2%) were between 40 and 49 years of age. In the over 49 category, there were 38 (18.3%) respondents. The average age was 39.74. Respondents ages ranged from 22 years to 61 years. Thirteen respondents did not indicate their age.

Table 6. Frequency and percentage distribution of respondents by age

Age in years		Frequency	Percent
Less than 30		36	17.3
30 - 39		67	32.2
40 - 49		67	32.2
More than 49		38	18.3
Missing data		13	--
Mean	39.7		

Occupational areas taught

Respondents were asked to indicate which occupational area best described their overall program. The seven occupational areas listed are identified by the United States Department of Education (1963) as components of the secondary agricultural program. They are: (a) Agriculture Sales & Service, (b) Forestry, (c) Horticulture, (d) Conservation & Natural Resources, (e) Agricultural Production, (f) Agricultural Mechanics, and (g) Agricultural Products & Processing. Many respondents indicated several areas as best describing their program, thus increasing the total frequency count to 436.

Some respondents chose to list specific subjects in agriculture as "Other" occupational areas. These subjects included Agricultural Science, Agricultural Business, Veterinary Science, Agricultural Management, Home Construction, Agricultural Industry, General Mechanics, Agricultural Literacy, Agricultural Marketing, Construction Work, Biotechnology, and Landscaping. Table 7 provides the frequency and response percentage distribution according to occupational areas taught.

Agricultural education program enrollment

In Table 8, information on agricultural education program enrollment is provided. Enrollment ranged from eight students in the program of one respondent to 350 students enrolled in another respondent's program. The average enrollment was 82.60 students per program.

Table 7. Frequency and response percentage distribution by occupational areas taught

Occupational area taught	Frequency	Response percentage
Agriculture Sales & Service	44	20.4
Forestry	21	9.7
Horticulture	57	26.4
Conservation & Natural Resources	52	24.1
Agricultural Production	132	61.1
Agricultural Mechanics	72	33.3
Agricultural Products & Processing	23	10.7
Other	35	16.2

Table 8. Frequency and percentage distribution of respondents by agricultural education program enrollment

Agricultural education enrollment	Frequency	Valid percent
Less than 31 students	18	8.1
31 - 60 students	59	26.7
61 - 90 students	68	30.8
91 - 120 students	31	17.6
121 - 150 students	25	11.3
More than 150 students	12	5.4
Mean 82.6		

Facilities available for instruction in agricultural mechanics

As can be observed in Table 9, 193 (88%) respondents had shop facilities, 99 (46%) had greenhouse facilities, 99 (46%) had land labs, and other facilities, such as computer labs, aquaculture labs, school forests, and nature learning centers were available at 39 of the respondents' programs.

Table 9. Frequency and response percentage distribution by agricultural mechanics facilities available for instruction

Facilities	Frequency	Response percentage
Shop	193	88.0
Greenhouse	99	46.0
Land Lab	99	46.0
Other	39	18.0

<u>Adult education taught</u>

Table 10 indicates that the majority of the respondents (85.0%) do not teach any adult education classes.

Perceptions of Agricultural Educators

One of the major objectives of this study was to identify perceptions held by secondary agricultural education teachers regarding selected concepts in agricultural mechanization education. Section I of the questionnaire focused specifically on perceptions regarding the role of agricultural mechanization in the agricultural education curriculum.

Table 11 provides information regarding agricultural educators' perceptions regarding the role of agricultural mechanics in the Agricultural Education curriculum. Respondents were asked to indicate their level of agreement with ten statements about the role of agricultural mechanics in agricultural education. The scale ranged from "Strongly Disagree" to "Strongly Agree."

Question number one was: "Most secondary school agricultural education instructors are under pressure to reduce the amount of time for agricultural mechanics instruction." It can be observed that 30.2% of respondents "Disagreed" or "Strongly Disagreed" with the statement. The percentage of instructors that "Agreed" or "Strongly Agreed" with the statement was nearly 50%.

Table 10. Frequency and percentage distribution of respondents by whether or not they teach adults

Adult education taught	Frequency	Valid percent
Yes	32	15.0
No	182	85.0

Table 11. Frequencies, percentages, means, and standard deviations of perceptions regarding the role of agricultural mechanics in the agricultural education curriculum

Perception statement	Strongly disagree[a]	Disagree	Neutral	Agree	Strongly agree	Total N	Mean S.D.
1. Most secondary school agricultural education instructors are under pressure to reduce the amount of time for agricultural mechanics instruction.	11 5%	54 25%	54 25%	69 32%	27 13%	215	3.22 1.11
2. Stand-alone courses in agricultural mechanics are critical components of agricultural education programs.	1 1%	23 11%	43 20%	90 42%	59 27%	216	3.85 .96
3. Agricultural mechanics concepts and skills should be integrated into other agriculture courses in the program.	0 0%	17 8%	41 19%	113 53%	44 21%	215	3.86 .83
4. There should be a reduced emphasis in agricultural mechanics instruction on subject content areas relating specifically to production agriculture.[b]	31 14%	97 45%	43 20%	43 20%	2 1%	216	2.48 1.00
5. Courses in agricultural mechanics at the secondary level should primarily emphasize the development of employment skills.	5 2%	48 22%	51 24%	91 42%	20 9%	215	3.34 1.00
6. Instruction in agricultural mechanization should focus on developing general	0 0%	12 6%	19 9%	135 63%	49 23%	215	4.03 .74

[a]Scale: 5=Strongly Agree; 1=Strongly Disagree.

[b]Item reverse scored.

Table 11. Continued

Perception statement	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Total N	Mean S.D.
knowledge and skills that are transferable to a wide range of job clusters rather than specific knowledge and skills that focus on a specific job in a job cluster.							
7. High school students need an opportunity to design, build, and take home projects involving good craftsmanship to develop healthy self-concepts, self-esteem, and pride in quality workmanship.	0 0%	5 2%	11 5%	107 50%	93 43%	216	4.33 .68
8. Instruction in agricultural mechanics should be modeled around a systems concept that addresses basic systems found in complex machines such as fluid power systems, electrical systems, water systems, etc. rather than the traditional areas such as concrete and masonry, hot and cold metals, tractor mechanics, etc.	11 5%	49 23%	59 27%	81 38%	16 7%	216	3.19 1.03
9. Courses in agricultural mechanics at the secondary level should be science-based, applied physics with applications in agriculture.	5 2%	34 16%	66 31%	95 44%	16 7%	216	3.38 .92
10. Agricultural mechanics instruction in most high school agricultural education programs adequately addresses the educational needs of both college bound and non-college bound students.	6 3%	52 24%	65 30%	85 39%	8 4%	216	3.17 .93

"Stand-alone courses in agricultural mechanics are critical components of agricultural education programs" was the second question. Responses to this statement indicated that the majority (69%) "Agreed" or "Strongly Agreed." Those "Disagreeing" or "Strongly Disagreeing" numbered 24 (12%).

The next question, "Agricultural mechanics concepts and skills should be integrated into other agriculture courses in the program," elicited 73.1% "Agree" or "Strongly Agree" responses. "Disagree" accounted for 7.9% of responses, and no respondents "Strongly Disagreed" with the statement.

Almost 60% of respondents "Strongly Disagreed" or "Disagreed" with the statement: "There should be a reduced emphasis in agricultural mechanics instruction on subject content areas relating specifically to production agriculture." Only 20.8% "Agreed" or "Strongly Agreed" with the statement. This statement was negatively written; by indicating disagreement with the statement, respondents were indicating that there should not be a reduced emphasis in agricultural mechanics instruction on subject content areas relating specifically to production agriculture.

Question five read, "Courses in agricultural mechanics at the secondary level should primarily emphasize the development of employment skills." Respondents indicated "Agree" or "Strongly Agree" at 51.6%, while "Disagreeing" or "Strongly Disagreeing" at 24.6%. Neutral respondents accounted for 23.7% of the group.

"Instruction in agricultural mechanization should focus on developing general knowledge and skills that are transferable to a wide range of job clusters rather than specific knowledge and skills that focus on a specific job in a job cluster" was statement number six. A consensus was reached concerning this statement with 85.6% of respondents "Agreeing" or "Strongly Agreeing" with the issue. Those "Disagreeing" made up 5.6% of respondents, while no respondents "Strongly Disagreed" with the statement.

The next statement read, "High school students need an opportunity to design, build, and take home projects involving good craftsmanship to develop healthy self-concepts, self-esteem, and pride in quality workmanship." Consensus was again reached with 92.6% of respondents "Agreeing" or "Strongly Agreeing" with the statement. The mean for this group was 4.33 and the standard deviation was .68.

Respondents totaling 44.9% "Agreed" or "Strongly Agreed" with the statement: "Instruction in agricultural mechanics should be modeled around a systems concept that addresses basic systems found in complex machines such as fluid power systems, electrical systems, water systems, etc. rather than the traditional areas such as concrete and masonry, hot and cold metals, tractor mechanics, etc." Those "Disagreeing" or "Strongly Disagreeing" with the statement accounted for 27.8% of the respondents.

"Courses in agricultural mechanics at the secondary level should be science-based, applied physics with applications in agriculture" was the next statement. The total number of respondents "Agreeing" or "Strongly Agreeing" with the statement were 111 (47.4%), respondents "Disagreeing" or "Strongly Disagreeing" were 39 (18%). Instructors that were neutral on this question totaled nearly 31%.

The final statement, "Agricultural mechanics instruction in most high school agricultural education programs adequately addresses the educational needs of both college bound and non-college bound students" indicated 43.1% of respondents "Agreeing" or "Strongly Agreeing," while 26.9% "Disagreed" or "Strongly Disagreed."

Instructional Areas Taught

In meeting the second objective of the study, to determine instructional areas in agricultural mechanization being delivered at the time of the study in secondary agricultural education programs, respondents were asked to indicate if they taught any of 32 specified instructional areas in agricultural mechanics. Table 12 indicates the frequency and valid percent for each instructional area being taught.

Table 12. Frequency and percentage distribution of instructional areas currently taught

Item	Frequency	Valid percent
Safety	207	97.2
Welding	184	86.8
Electricity	171	80.7
Small Engines	165	77.8
Machinery Maintenance & Operation	161	76.3
Buildings & Structures	152	71.0
Hot Metal Work	148	69.8
Computers (PC)	144	67.0
Woodworking	141	66.5
Cold Metal Work	135	63.4
Surveying	129	60.8
Greenhouse Operations	119	56.4
Concrete	118	55.1
Multi-Cylinder Engines	108	50.9
Plumbing	105	49.5
Hydraulics	103	48.6
Hydroponics	100	46.9
Waste Management Systems	82	38.7
Drafting	76	35.5
Water Systems	75	35.4
Environmental Systems	72	34.0
Machine Systems	68	32.2
Precision Farming Systems	49	23.1
Ventilation Systems	48	22.6
Irrigation Systems	46	21.6
Climate Controlled Facilities	46	21.5
Alternative Power Systems	45	21.0
Electronics	42	19.8
Computer-Operated Machines	34	15.9
Electronic Monitoring Devices	32	14.5
Robotics	16	7.5
Lasers	14	6.6

Additionally the table lists the instructional areas in descending order according to the number of respondents who indicated they taught in the instructional area.

As can be observed from Table 12, "safety" was the instructional area taught by the highest number of respondents with over 97% of programs teaching in this area. "Welding" was the next subject taught by a high number of teachers at a percentage of nearly 87%. "Electricity," "small engines," and "machinery maintenance and operation" were also taught by a high number of teachers. The subject areas not taught by many teachers included "robotics" at 7.5% and "lasers" at 6.6%.

Degree of Expansion Within Instructional Areas

The third objective of the study was to identify instructional areas in agricultural mechanization perceived to be needed in future agricultural education programs. This was accomplished by having each instructor indicate the degree of expansion they would like to see in each instructional area, given needed materials and in-service education. They were asked to rate expansion with a scale ranging from 1) "No Expansion" to 5) "Very High Expansion." It was emphasized in the questionnaire that expansion would come with appropriate in-service education and instructional materials.

Illustrated in Table 13 are the means and standard deviations for the degree of expansion desired within each instructional area. "Computers (PC)" was the area where the most expansion was needed, with a mean of 3.50. Viewed next as needing expansion were "Safety," "Greenhouse Operations," "Hydroponics," and "Welding"; with mean scores ranging from 3.34 to 2.85.

The lowest mean score was observed for the instructional area "Irrigation Systems" (2.01). Other instructional units having low means were "Lasers" (2.07), "Robotics" (2.11), "Climate Controlled Facilities" (2.18), and "Machine Systems" (2.19). The frequencies for expanding instructional areas ranged from 184 to 204.

Table 13. Frequencies, means, and standard deviations for degree of expansion within instructional areas in descending order by means

Item	n[a]	Mean[b]	S.D.[c]
Computers (PC)	204	3.50	1.22
Safety	197	3.34	1.12
Greenhouse Operations	191	3.14	1.25
Hydroponics	193	2.90	1.18
Welding	194	2.85	1.19
Computer-Operated Machines	193	2.77	1.34
Small Engines	194	2.76	1.15
Electricity	197	2.73	.98
Machinery Maintenance & Operation	196	2.69	.99
Buildings & Structures	195	2.69	1.01
Hydraulics	195	2.59	1.08
Surveying	195	2.55	1.04
Environmental Systems	187	2.53	1.17
Hot Metal Work	191	2.52	1.10
Precision Farming Systems	190	2.50	1.28
Woodworking	192	2.41	1.15
Multi-Cylinder Engines	190	2.40	1.07
Waste Management Systems	189	2.33	1.14
Electronic Monitoring Systems	185	2.32	1.14
Alternative Power Systems	196	2.31	.98
Plumbing	194	2.31	1.09
Water Systems	189	2.31	1.10
Cold Metal Work	197	2.30	1.03
Electronics	188	2.29	1.11
Drafting	196	2.29	1.18
Concrete	196	2.23	.97
Ventilation Systems	189	2.23	1.10
Machine Systems	186	2.19	1.00
Climate Controlled Facilities	192	2.18	1.06
Robotics	185	2.11	1.20
Lasers	184	2.07	1.18
Irrigation Systems	191	2.01	1.03

[a]The n for each item ranged from 184 to 204.

[b]Scale used to determine mean was 1 to 5.

[c]S.D.=standard deviation.

Synthesis of Written Comments

Forty-eight respondents included written comments which added to the findings of this study. The common theme throughout was that agricultural mechanization in its many forms was, and still is a viable component of the Agricultural Education curriculum. The importance of the program stemmed from the "hands-on" experiences involving physical skills, critical thinking, problem-solving, and communication skills. Students continue to be highly interested, and traditional subjects such as small engines, welding, electricity, concrete, and others were all mentioned as being important components in their program. Courses in physical science applications in agriculture and biological science applications in agriculture were both taught for science credit.

Several respondents indicated that some instructional areas such as robotics, electronics, woodworking, welding, and others were being taught by other departments such as Industrial Arts, Technology Education, and Auto Mechanics.

Administrative concerns mentioned included a general shortage of funding for necessary projects and advances in curriculum in order to keep pace with the scope of agriculture. Issues of inadequate training in these areas, along with liability concerns, affected both large and small schools. Whereas larger schools were able to provide monetary support to programs, smaller schools with budget limitations were more likely to look to class integration in order to meet the necessary requirements of class size and efficient use of teaching personnel. (See Appendix E for specific written comments.)

Summary

The findings were analyzed and presented in the order of the objectives of the study. Descriptive information was presented about the respondents according to teachers per program, years of experience teaching agricultural education, instructor's level of education, age, occupational areas taught, agricultural education program enrollment, agricultural mechanics facilities, and adult education taught.

The following paragraphs summarize the major findings of this investigation.

Over 92% of the respondents agreed or strongly agreed with perception question number seven, that high school students need the experience of designing, building, and taking home projects involving good craftsmanship to develop healthy self-concepts, self-esteem, and pride in quality workmanship.

Nearly 85% of respondents agreed or strongly agreed with perception question number six, that instruction should emphasize developing general skills and knowledge that are transferable to a wide range of job clusters, rather than specific knowledge and skills that focus on a specific job in a job cluster.

With the lowest mean of the total perception questions, 60% of instructors indicated that there should not be a decrease in the emphasis on agricultural mechanics within agricultural education.

Instructional areas taught by the highest number of instructors included "safety," "welding," "electricity" and "small engines." Those instructional areas taught by fewer instructors included "lasers" and "robotics."

More instructors indicated they would expand instruction in "computers (PC)," "safety," and "greenhouse operations." Areas that were not rated highly for expansion included "irrigation systems," "lasers," and "robotics."

Chance relationships existed in the instructional categories of "soil and water management" and "other," when compared to age, student enrollment, and years of experience of respondent.

There were no significant differences among the respondents when grouped by age, student enrollment, instructors' years of experience and analyzed with perception questions in Part I of the questionnaire.

Age had no significant influence on the degree of expansion perceived in the instructional areas.

There was a significant difference among respondents when grouped by student enrollment and analyzed with degree of expansion within instructional categories. Programs with less than 30 students enrolled in general did not favor expansion in the areas of "structures," "soil and water management," and "other," which included alternative power sources, safety, and woodworking.

CHAPTER V. DISCUSSION

The purpose of this study was to determine the perceptions of agricultural educators regarding the role of agricultural mechanization in the agricultural education curriculum in secondary schools throughout the Central Region of the United States. The study sought to draw implications to teacher education programs to provide direction for enrichment of the curriculum.

Specific objectives of the study were: (a) to identify perceptions held by secondary school teachers regarding selected concepts in agricultural mechanization education, (b) to determine instructional areas in agricultural mechanics currently being delivered in secondary agricultural education programs, (c) to identify the degree to which instructional areas in agricultural mechanics could be expanded in future agricultural education programs, (d) to identify selected demographic data of secondary school teachers of agriculture, and (e) to design a practical curriculum model for development of agricultural mechanization in agricultural education programs.

The study employed a descriptive design and was considered appropriate for describing the perceptions of respondents regarding the agricultural mechanization curriculum within agricultural education.

This chapter presents a discussion of the findings reported in Chapter IV, with implications of the findings, and a suggested curriculum model for agricultural mechanics within agricultural education. The discussion is organized around the objectives which guided this study. The chapter is divided into the following sections: (a) the role of agricultural mechanization in the agricultural education curriculum, (b) critique of the research design: lessons learned, (c) perceptions of agricultural educators, (d) instructional areas being taught, (e) degree of expansion within instructional areas, (f) a curriculum model for agricultural technology education within secondary agricultural education programs, and (g) implications to teacher education programs.

The Role of Agricultural Mechanization in the Agricultural Education Curriculum

The development of skills to assist knowledge is a necessary part of any curriculum. Agricultural mechanization brings to the curriculum the necessary realization for the student that knowledge is not very useful without a basis for application on life.

The role of agricultural mechanization in the agricultural education curriculum is that of reinforcement. This takes place by:

1. providing students the opportunity to design, build, and take home projects in order to develop healthy concepts such as self-esteem and pride in workmanship.
2. providing an atmosphere where knowledge and skills from other coursework areas and experiences can be applied to a wide variety of life situations.
3. providing a forum to develop skills of interaction and the healthy exchange of ideas through group and project opportunities.
4. providing situations where critical thinking skills can be utilized both individually and in group settings.
5. providing discipline through task undertaking and completion.

Critique of the Research Design: Lessons Learned

This study utilized descriptive survey methodology which allows the researcher to obtain information concerning the current status of a phenomena; to determine the nature of a situation as it exists at the time of the study (Ary, Jacobs, & Razaviech, 1990).

In this study the researcher attempted to generate an accurate description of agricultural mechanization curricula within secondary agricultural education programs as they existed at the time of the study; to then be able to explain or change it. The descriptive survey methodology proved to be appropriate for providing data upon which generalizations could be made that would address the research purpose and objectives.

The pre-testing of the survey instrument proved valuable in designing the questionnaire. Perhaps the greatest benefit of the pre-testing was the decision to consolidate Part II into instructional areas instead of individual competencies. This resulted in a decrease of approximately 64 variables, which could have decreased response rate significantly.

The perception questions in Part I were all independent of each other and were determined by the researcher to be appropriately worded to gain the information needed for development of a curriculum model for agricultural mechanization.

The questions were generated as a result of the Delphi study administered by Eighmy (1995). However, because of the independency of each question, a pre-test, post-test on reliability could have been a more appropriate evaluation.

Part II of the instrument looked at instructional areas currently being taught and the degree of expansion the respondents would consider given appropriate in-service education and instructional materials. In the "currently taught" section, the researcher determined the best response would be a specific "yes" or "no." This format could be answered easily by the respondents; however, this eliminated the possibility of comparing what was being taught to the degree of expansion instructors would consider in each instructional area because of the differences in the two scales.

Perceptions of Agricultural Educators

The first research question stated, "Identify perceptions held by secondary agricultural education teachers regarding selected concepts in agricultural mechanization education." This was accomplished by discussing each concept and evaluating responses.

"Most secondary school agricultural education instructors are under pressure to reduce the amount of time for agricultural mechanics instruction" was the first concept to which instructors were asked to respond. About half of the respondents agreed with this statement. Buriak (1992) stated that agricultural mechanics is viewed by some agricultural educators as a non-essential area of instruction. Further, Osbome (1992) stated that many agricultural educators are concerned that agricultural mechanics instruction is being forgotten in curricular reform, indicating that in many instances the agricultural mechanics component is not getting the attention other content areas are. As instructors are budgeting their time in content areas, clearly the areas thought to be most important will receive the most instruction time.

Concept number two was, "Stand-alone courses in agricultural mechanics are critical components of agricultural education programs." Respondents clearly agreed with this statement. According to a study conducted by Schlautman and Foster (1991) regarding the Nebraska secondary agricultural mechanization curriculum within agricultural education, 30% of the program should be devoted to teaching agricultural mechanics. Most of the literature (Buriak, 1992; Osborne, 1992; Gliem, 1992; and others) expressed the need to integrate agricultural mechanization into the other areas of agricultural education. However, it is evident that secondary instructors favor keeping the stand-alone courses.

"Agricultural mechanics concepts and skills should be integrated into other agriculture courses in the program" was the third concept presented. Respondents were in agreement with the statement, and as previously pointed out, much of the current literature calls for integration across subject areas. From the response to the last statement regarding stand-alone courses in agricultural mechanization, and the response to this statement, it was surprising that instructors perceived that both stand-alone courses in agricultural mechanics and integration with other content areas were desirable.

Instructors disagreed with statement number four, "There should be a reduced emphasis in agricultural mechanics instruction on subject content areas relating specifically to production agriculture." This would seem to indicate that the instructors currently teaching at the secondary agricultural level perceive that agricultural mechanics instruction relating to production agriculture is still a much needed part of the total agricultural mechanics program. The Committee on Agricultural Education in Secondary Schools, established by the National Research Council, stated that there should be a reduced emphasis on production agriculture in vocational agriculture programs (NRC, 1988). Production agriculture no longer represents the major area of employment in the agriculture industry for secondary school graduates. However, the respondents in this study clearly perceived that production agriculture applications of agricultural mechanics are still a very viable and important part of their programs.

"Courses in agricultural mechanics at the secondary level should primarily emphasize the development of employment skills" was statement number five. Slightly over half of the respondents agreed with this sentence. The other half of the respondents were split between disagreeing with the statement or remaining neutral. Clearly employment skills are important to the instructors, as evidenced by half of the group's support of the statement. However, since only half of the group agreed with the statement, other skills and knowledge must also remain an important part of the agricultural mechanics curriculum.

Concept number six read, "Instruction in agricultural mechanization should focus on developing general knowledge and skills that are transferable to a wide range of job clusters rather than specific knowledge and skills that focus on a specific job in a job cluster." Instructors highly agreed with this statement.

Kennedy (1993) in Preparing for the Twenty-First Century, stated that as technological innovations create new jobs and destroy old ones, we will need to rethink, retrain, and retool for the future. Teaching general knowledge and skills that transfer to a wide range of job clusters will provide a more viable education for today's student. Today's students will most likely change jobs numerous times during their working careers. Osborne (1992) called for a shift from a product focus to a process focus within agricultural mechanics instruction. Understanding the big picture, the process behind "why" a practice or skill is performed, and then being able to apply that knowledge and skill in various ways, are the tools with which we want to equip today's students.

Respondents overwhelmingly agreed with perception statement number seven, "High school students need an opportunity to design, build, and take home projects involving good craftsmanship to develop healthy self-concepts, self-esteem, and pride in quality workmanship." Agricultural education has been a hands-on, learning by doing program since its inception. That is one of the strengths of the program. By applying the knowledge and skills students have acquired to a project personally appealing to that student, education becomes real and useful. Experiential learning is exemplified in the designing and building of projects. In Shinn's (1995) study, current strengths of the agricultural mechanics program were identified as continuing active learning by doing and developing positive self-esteem among all students, especially under-achievers. Clearly, the use of appropriate projects is a way of providing this type of education, as the vast majority of the respondents indicated.

"Instruction in agricultural mechanics should be modeled around a systems concept that addresses basic systems found in complex machines such as fluid power systems, electrical systems, water systems, etc. rather than the traditional areas such as concrete and masonry, hot and cold metals, tractor mechanics, etc." Respondents concurred with this statement. Eighmy's (1995) study supports the concept that subject matter content must ideally focus on universal systems found in complex agricultural machines and structures, rather than the traditional self-contained areas of study used in the past.

The majority of instructors (51%) agreed with statement number nine, "Courses in agricultural mechanics at the secondary level should be science-based, applied physics with applications in agriculture." Current literature (Eighmy, 1995; Buriak, 1992; Lawver & Fraze, 1992; Osborne, 1992) overwhelmingly supports this statement, and many agricultural educators are calling for this to be the major focus of curricular reform.

"Agricultural mechanics instruction in most high school agricultural education programs adequately addresses the educational needs of both college bound and non-college bound students." Nearly 44% of the instructors agreed with this statement. About 27% of instructors felt that the needs of both college bound and non-college bound students were not being adequately addressed. The National Research Council's (1988) study found that much of the focus and content of today's vocational agriculture programs is out of date, therefore student needs are not always being met. The study also found that vocational agriculture programs are uneven in quality, calling for programs not meeting educational needs to be upgraded, consolidated, or phased out. Eighmy's (1995) study found that agricultural mechanics programs in most high school agriculture departments are <u>not</u> adequately addressing the needs of students, therefore Eighmy recommended that the structure and content of these programs be revised.

Instructional Areas Being Taught

The second objective of the study was to identify instructional areas in agricultural mechanization being delivered in secondary agricultural education programs. Thirty-two instructional areas within agricultural mechanics were specified. Of the 32, the instructional area taught the highest number of teachers was "Safety," with over 97% of the programs teaching in this area.

The importance of safety throughout the agriculture industry has been well documented, as work in agricultural mechanics in particular is inherently hazardous. Laird (1994) agreed, stating that many students have never worked with dangerous power tools or heavy equipment prior to taking their secondary agricultural mechanics courses. Maintaining a safe work environment, and knowing how to operate tools and machinery safely and properly are vital components of agricultural mechanics instruction. It was appropriate and encouraging to find that instructors were first and foremost concerned with the safety of their students.

"Welding," "Electricity," "Small Engines," and "Machinery Maintenance and Operation" were also indicated as being taught by a large number of the respondents. The teaching of basic welding skills is an integral part of the agricultural mechanics curriculum. Not only the welding skills and knowledge learned benefit the student, but the process involved in this "learning by doing" activity teaches the student about applying knowledge learned, participating in a worthwhile activity as evidenced by projects completed, fosters a "can do" attitude as well as adaptability and cooperative skills, and builds self-confidence and self-esteem in students. It could be asked, why is it that welding, electricity and small engines rated high in both areas taught and expansion? The possible answer is that these areas of instruction are basic, fun areas to teach and teachers see them as being useful. With the emphasis on more physical science applications within agricultural mechanics, Lawver and Fraze (1992) gave an example of how physical science can be applied to welding instruction through discussion and experience with the scientific principles behind welding, which include electricity, chemical reactions, and properties of metals.

The instructional areas taught by few of the respondents included "Lasers," "Robotics," "Electronic Monitoring Devices," and "Computer-Operated Machines." Each of these instructional areas involves relatively new technology. The lack of instructor knowledge and instructional materials in these emerging fields may account for the lack of emphasis given these areas. Teachers tend to teach in subject areas with which they are familiar, and for which they have appropriate instructional materials, equipment, and facilities. Instructional areas involving new technologies and information require more preparation time as well, which would contribute to the fewer instructor's teaching in these areas. These instructional areas are, however, areas where more emphasis should be placed, as they deal with emerging technologies in agricultural mechanization; particularly in teacher preparation programs and in-service training.

Degree of Expansion within Instructional Areas

The third research question studied was to identify instructional areas in agricultural mechanization that could be expanded in agricultural education programs. Instructors were asked to indicate the degree of expansion they would like to see in each instructional area, given needed materials and in-service education.

The instructional area "Computers (PC)" had the highest rating for expansion of instruction with a mean of 3.50. Several current studies (Shinn, 1995; Laird, 1994; Newman & Johnson, 1993) have emphasized the need for additional instruction in computers and their applications. The need for in-service education and instructional materials is great in this area. Computer knowledge and skills are becoming increasingly critical in agricultural mechanics as agricultural machinery and processes are utilizing computers and their applications at an ever increasing rate. The "computer literate" person has more opportunities in today's job market than someone lacking in expertise in this area. Computers are in evidence throughout today's society, and their applications continue to increase; making it necessary for society as a whole to become somewhat knowledgeable in their use.

"Safety" was the instructional area receiving the next highest rating on the expansion scale. Since this area was the area taught by the highest number of respondents as well, this study would seem to indicate, that instructors see a need for increased emphasis in this area. Because of the hazardous nature of agricultural mechanization activities, and the responsibility of instructors and institutions for the safety of their students, continual vigilance and improvement in this area is needed. Also, as new technologies are included in the agricultural mechanization curriculum, the safety practices that go along with the new technologies must be implemented.

Respondents indicated a high degree of expansion in the instructional areas of "Greenhouse Operations" and "Hydroponics." Scientific and technological advances in both of these areas clearly need to be included in today's agricultural mechanics curriculum. As the curriculum moves away from its primarily "production agriculture" emphasis, an area such as "Greenhouse Operations," with many urban applications, is a logical program to expand.

"Welding" was also indicated by respondents as an area where expansion could change with a mean of 2.85. Respondents indicated that welding is an important component of the agricultural mechanics curriculum and they would expand instruction in this area. Additionally, facilities and equipment are always factors in the extent to which welding can be taught, as is the instructor's knowledge of the instructional area. Laird (1994) discussed the importance of welding units within secondary agricultural mechanics.

The instructional area instructors indicated as an area of little expansion was "Irrigation Systems" with a mean of 2.01. Additional areas that instructors were least in favor of expanding included "Lasers," and "Robotics." These two areas are both relatively new areas of technology, therefore instructors may not be as interested in them because of a lack of proper equipment or facilities to teach them. Additionally, not everything can be taught because of time and financial constraints. Therefore, instructors must make decisions about curriculum and what can be taught. These may be areas that instructors feel are not priority areas.

A Curriculum Model for Agricultural Technology Education within Secondary Agricultural Education Programs

The fifth objective of this study was to design a practical curriculum model for agricultural mechanization in agricultural education programs. The literature review provided the researcher with a basis in curriculum theory and development from which to begin to formulate ideas for a model in agricultural technology curriculum within secondary agricultural education programs. The researcher defines curriculum as the formal and informal content and process by which learners gain knowledge and understanding, develop skills, and alter attitudes and values. The curriculum can be planned or hidden. Further, the curriculum is more than just a body of knowledge, the curriculum is what the teacher does, what the teacher knows, and who the teacher is. Curriculum models were examined, to gain insight into what models have been developed, and how they might be applied within agricultural technology.

The findings of this study guided the researcher in the design of the model by analyzing responses to perception questions and written comments provided by the secondary agricultural education instructors . The responses to the perception questions led directly to both the delivery systems, and curriculum inputs and outcomes sections of the model.

The model, Curriculum Model for Agricultural Technology Education (CMATE) within secondary agricultural education programs, is presented in Figure 1. The researcher used the name "Agricultural Technology" as opposed to "Agricultural Mechanization." Previous studies (Eighmy, 1995; Shinn, 1995) stated that a more modern descriptor would help the image of agricultural "mechanics"; the researcher agreed that the term "technology" was more all-encompassing than "mechanics."

The student in agricultural technology education is located at the heart of the model with all its components focused on the student's education. The circle around the student encompasses the delivery systems which include:

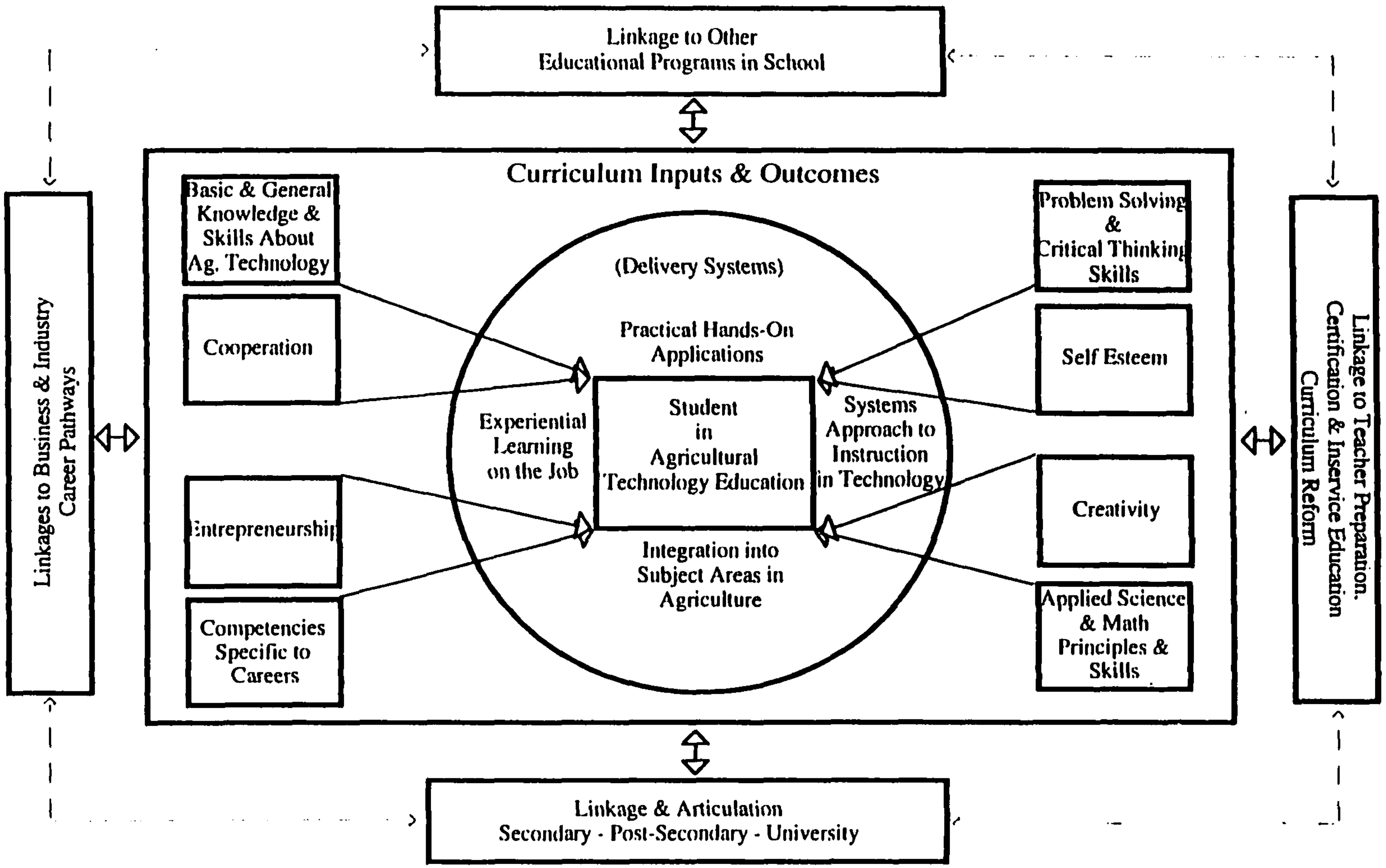

Figure 1. Curriculum Model for Agricultural Technology Education (CMATE)

1. Practical hand-on applications
2. Experiential learning on the job
3. Systems approach to instruction in technology
4. Integration into subject areas in agriculture.

The first component, "Practical hands-on applications," requires that the students are given the opportunity to actually engage in learning through practical applications of the concepts learned. Designing and building appropriate projects would be an example.

The second component, "Experiential learning on the job," is tied very closely to practical application. However, efforts should be made by the instructor to simulate the "on the job" aspect of this component. Lawn mowers could be brought in for repairs and/or maintenance, or in a greenhouse situation, ornamental plants could be grown for sale to the local community. Either example could be simulated using a business-type atmosphere.

The third component, "Systems approach to instruction," involves teaching the interrelated concepts together rather than as individual units. A greenhouse example could show how watering of plants affects the heating and cooling system.

The fourth component, "Integration into subject areas in agriculture," involves integrating agricultural technology throughout the agricultural education curriculum. A horticulture class offering instruction in operation and maintenance of small engine power equipment (lawn mowers, rototillers, etc.) used in routine maintenance of a landscaped areas would be an example of this.

All curriculum inputs and outcomes must be concerned with as many of the four areas within the delivery system as possible.

The large rectangular box entitled "Curriculum Inputs and Outcomes," encompasses input areas of instruction as determined by desired curriculum outcomes within an institution's mission and philosophy. The eight distinctive components of curriculum identified in this model that should be incorporated into every subject area taught included:

1. Basic and general knowledge and skills about agricultural technology
2. Cooperation
3. Entrepreneurship
4. Competencies specific to careers
5. Problem-solving and critical thinking skills
6. Self esteem
7. Creativity
8. Applied science and math, principles and skills.

Basic and general knowledge and skills about agricultural technology involves instruction in a wide range of information about agricultural technology. Development of student awareness involves general instruction in agricultural technology and its relationship to other areas of agriculture, as well as other areas of general education. Eighty-six percent of the respondents agreed that instruction in agricultural mechanization should focus on developing general knowledge and skills that are transferable to a wide range of job clusters.

Cooperation and entrepreneurship are both focused on the development of interpersonal skills. Business atmosphere includes these skills and companies are looking for recruits who possess these on a high level. Small group projects define the spirit of cooperation and are excellent learning situations in which to develop these skills.

Competency Based Education has been the most widely used, traditional method of teaching agricultural mechanization. As discussed in Chapter II, competencies are agreed upon by the instructor and learner. Students progress at their own rate and a variety of learning activities and experiences can be utilized. Competencies in this component area focus on preparing the student for specific career goals.

The fifth component, "Problem-solving and critical thinking skills," are taught to increase a student's ability to make well-informed decisions. The systems approach to instruction focuses on the decision-making process by applying "decision rules," choosing one alternative, reviewing it, and finally deciding for or against the choice.

Self-esteem and Creativity are both focused on the development of personal skills and are necessary components in any learning environment. Personal skills can be assessed by the use of the authentic assessment method where instructors can monitor student performance individually and/or collectively; observing, assisting, and assessing continually throughout the learning process.

The last component within curriculum inputs and outcomes is "Applied Science and Math Principles and Skills," and involves utilizing these principles and teaching the "how" and "why" of the way things work. Students learn the science, physics or mathematical principles behind a concept, then the skills to apply those concepts. Osborne (1992, March) stated, "A new emphasis on physical science applications in agriculture will diversify agricultural mechanics instruction and appropriately maintain agricultural mechanics as an important component of secondary agricultural education" (pp. 3-4).

Encompassing the "Curriculum Inputs and Outcomes" section of the model are four distinct linkages which work together to provide the structural support needed. These linkages include:

1. Linkage to other educational programs in school.
2. Linkage to teacher preparation, certification and in-service education, curriculum reform.
3. Linkage and articulation, secondary-post-secondary-university.
4. Linkages to business and industry, career pathways.

The linkage to other educational programs within the school itself is imperative. Subject areas must have an understanding of how their contributing to the overall education of the student and when combined together provide the best possible educational program.

The second linkage is essential to the implementation of the model. Acceptance of curricular reform is slow at best; if the reform is too radical, it will not be adopted. Therefore, it is imperative that through in-service education, teachers are assisted in applying the model to their existing program. Not all parts of the model must be used in every course taught, but as many parts of the model that can be implemented should be. Through teacher certification programs, new teachers can become familiar with the model and its application in agricultural technology.

The third linkage, "Articulation between secondary, post-secondary and university programs," involves communication between the three entities to share ideas and concerns, to assist in implementation of the components of the model, to revise and improve components of the model, and to insure that knowledge and new developments are shared between educators at these levels.

The linkage to business and industry which provide the career pathways involves providing dialogue and action between the groups to make possible the experiences in education that provide authentic meaning for students. An example of a linkage with business would be through an apprentice program for students, which would provide an experiential learning opportunity for the student, and a better prepared possible future employee for the business.

The dotted lines which tie the linkage areas together show that communication should travel throughout all the linkage entities.

Implications to Teacher Education Programs

Implications can be drawn from this study for agricultural teacher education programs. The findings of the study and the review of literature indicated that agricultural mechanization is an integral component of agricultural education. Teacher education programs must continue to view agricultural mechanization as an integral part of agricultural education, and provide adequate educational opportunities in agricultural mechanization.

The need to revise the present, traditional curriculum in agricultural mechanization is apparent. The addition of a course in methods in laboratory instruction should be added to the curriculum. The course would focus on planning, delivery, and evaluating instruction in laboratory settings such as shops, greenhouses, and technology laboratories. Components identified in the Curriculum Model for Agricultural Technology Education as delivery systems should all be utilized. They include:

1. practical hands-on applications.
2. systems approach to instruction.
3. integration into subject areas in agriculture.
4. experiential learning.

Students should not be allowed to certify as qualified secondary agricultural educators without being properly educated in how to teach in a laboratory setting.

Teacher education programs should also be concerned that students are receiving the skills needed to empower them to properly prepare secondary students for either the workforce or continued education.

Without these modifications to teacher education programs, the agricultural mechanization emphasis could continue to decline, with the ultimate loss being that of limiting student career options.

CHAPTER VI. SUMMARY

This chapter provides a summary, conclusions and recommendations of the study. The chapter sections include: (a) Purpose, (b) Objectives, (c) Methods, (d) Conclusions, and (e) Recommendations.

Purpose

The purpose of this study was to determine the perceptions of agricultural educators regarding the role of agricultural mechanization in the agricultural education curriculum in secondary schools throughout the Central Region of the United States. The study sought to draw implications to teacher education programs to provide direction for enrichment of the curriculum.

Objectives

The objectives of this study were to:

1. Identify perceptions held by secondary school teachers regarding selected concepts in agricultural mechanization education.
2. Determine instructional areas in agricultural mechanization currently being delivered in secondary agricultural education programs.
3. Identify the degree to which instructional areas in agricultural mechanization could be expanded in future agricultural education programs.
4. Identify selected demographic data of secondary school teachers of agriculture.
5. Design a practical curriculum model for development of agricultural mechanization in agricultural education programs.

Methods

The study was conducted using the descriptive survey method. The target population consisted of all secondary agricultural education programs in the twelve states within the Central Region of the United States. The twelve states included in this region were: Ohio, Illinois, Minnesota, Wisconsin, Missouri, Iowa, Indiana, Kansas, Nebraska, Michigan, North Dakota and South Dakota. There were a total of 2,465 total programs within the twelve states region, resulting in a sample size of 335 for the study. A stratified random sample was developed to establish equal representation of the total sample population within each state. There were 216 usable responses received resulting from a response rate of 65%.

A mailed questionnaire was developed, consisting of three parts. Part I was designed to determine specific perceptions of secondary agricultural educators regarding the role of agricultural mechanization in the secondary agricultural education curriculum. Part II of the questionnaire consisted of 32 instructional areas in agricultural mechanization. Respondents were asked if they currently taught in each of the instructional areas, and to indicate the degree of expansion they would consider in that area, given appropriate in-service education and instructional materials. Part III consisted of eight demographic questions and included a section for respondents to provide written comments.

Statistical procedures used to analyze data included were frequencies, means, standard deviations, and t-tests.

Findings

Descriptive information was presented about the respondents according to teachers per program, years of experience teaching agricultural education, instructor's level of education, age, occupational areas taught, student enrollment, agricultural mechanics facilities, and adult education taught.

The following statements summarize the major findings of this investigation:

1. Respondents had the highest mean score with perception question number seven, that high school students need the experience of designing, building, and taking home projects involving good craftsmanship to develop healthy self-concepts, self-esteem and pride in quality workmanship.
2. Respondents also indicated that instruction should emphasize developing general skills and knowledge that are transferable to a wide range of job clusters, rather than specific knowledge and skills that focus on a specific job in a job cluster.
3. Instructional areas taught by the highest number of instructors included "safety," "welding," "electricity" and "small engines." Those instructional areas taught by fewer instructors included "lasers" and "robotics."
4. More instructors indicated they would expand instruction in "computers (PC)," "safety" and "greenhouse operations." Areas that were not rated highly for expansion included "irrigation systems," "lasers" and "robotics."
5. Programs with less than 30 students enrolled in general did not favor expansion in the areas of "structures," "soil and water management" and "other" category which included "alternative power sources," "safety" and "woodworking."
6. Written comments from respondents indicated:
   a. Agricultural mechanization is a viable component of the agricultural education curriculum.
   b. The most valued components were "hands-on" experiences involving physical skills, critical thinking, problem-solving and communication skills.
   c. Instructional areas such as "robotics," "electronics," "woodworking," "welding" and others were being taught by other departments such as Industrial Arts, Technology Education and Auto Mechanics.

d. Concerns mentioned included a general shortage of funding for projects and curriculum advances, and issues of inadequate training in these areas along with liability concerns affected both large and small schools.

Conclusions

Based on the results of this study, the following conclusions were drawn:

1. A majority of the respondents indicated they used a traditional curriculum in agricultural mechanization (e.g., safety, welding, electricity, small engines, etc.), with the addition of a few new areas of instruction.
2. Under given circumstances, respondents indicated potential expansion of instruction in selected areas of instruction (e.g., computers, safety and greenhouse operations).
3. Overall, the respondents were part of a fairly homogeneous group of teachers in the central region of the United States. Most respondents were teaching a very traditional agricultural mechanics program.
4. Respondents indicated that agricultural mechanization is a vital and important area of the curriculum in agricultural education.
5. Comments by respondents suggest a large number of challenges facing teachers of agricultural mechanization, in particular, and agricultural education in general.

Recommendations

Based on the findings and conclusions of the study, the following recommendations were made:

1. Continue to include agricultural mechanization instruction as a part of the secondary agricultural education curriculum, with revisions reflected in the Curriculum Model for Agricultural Technology Education.

2. Develop instructional materials for topics that are increasing in importance such as computers, emerging technologies, science and math-based applications; as well as materials for teaching utilizing the systems approach, problem-solving and critical thinking skills, and ways to integrate the agricultural technology curriculum within other curricular areas.
3. Provide in-service education opportunities in agricultural education for teachers of agriculture to expand instruction in selected areas of agricultural mechanization.
4. Teacher preparation programs must ensure that their students have the skills necessary to teach the courses in agricultural technology, including lab teaching and management instruction identified as important instructional areas in this study.
5. Integrate Agricultural Technology into the other occupational areas within agricultural education.
6. Implement and use the CMATE model in secondary agricultural education. The model should be used in all courses in agricultural technology.

Recommendations for Further Study

1. The curriculum model (CMATE) designed as a result of this study should be tested and analyzed in the field to determine its usefulness.
2. Studies need to be conducted to determine the effectiveness of agricultural mechanics education.
3. Similar studies such as this one should be conducted in other regions of the U.S.A. to determine if there are similarities or differences among teachers in these regions.

APPENDIX A. HUMAN SUBJECTS APPROVAL

Last Name of Principal Investigator Rosencrans

Checklist for Attachments and Time Schedule

The following are attached (please check):

12. [X] Letter or written statement to subjects indicating clearly:
    a) purpose of the research
    b) the use of any identifier codes (names, #'s), how they will be used, and when they will be removed (see Item 17)
    c) an estimate of time needed for participation in the research and the place
    d) if applicable, location of the research activity
    e) how you will ensure confidentiality
    f) in a longitudinal study, note when and how you will contact subjects later
    g) participation is voluntary; nonparticipation will not affect evaluations of the subject

13. [ ] Consent form (if applicable)

14. [ ] Letter of approval for research from cooperating organizations or institutions (if applicable)

15. [X] Data-gathering instruments

16. Anticipated dates for contact with subjects:

First Contact	Last Contact
3/18/96	4/30/96
Month / Day / Year	Month / Day / Year

17. If applicable: anticipated date that identifiers will be removed from completed survey instruments and/or audio or visual tapes will be erased:

Upon Receipt

Month / Day / Year

18. Signature of Departmental Executive Officer — Date — Department or Administrative Unit

Richard Carter — 2-27-96 — Agricultural Education and Studies

19. Decision of the University Human Subjects Review Committee:

X Project Approved ___ Project Not Approved ___ No Action Required

Patricia M. Keith — 3/6/96 — PM Keith

Name of Committee Chairperson — Date — Signature of Committee Chairperson

GC: 8/95

APPENDIX B. COVER LETTER AND DATA COLLECTION INSTRUMENT

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Department of Agricultural Education and Studies
201 Curtiss Hall
Ames, Iowa 50011-1050
Administration and Graduate Programs 515 2
Research and Extension Programs 515 2
Undergraduate Programs 515 2

April 11, 1996

Dear Ag. Ed. Instructor:

The role of agricultural mechanization in the Agricultural Education curriculum in secondary schools is an important issue. Numerous articles have been written and several studies conducted regarding the need to evaluate today's agricultural mechanization programs. However, most of these results have been established from the perceptions of agricultural educators at the post-secondary level. It is the intent of this study to determine the perceptions held by agricultural educators at the high school level.

We are collecting information from vocational agriculture teachers within the central states region of the U. S. A. We hope that you will assist us in identifying the importance of agricultural mechanics knowledge and skills and the degree to which instruction is given in these areas. Your response to this questionnaire is essential in determining the perceptions of secondary agricultural educators.

Your responses will be held in strict confidence and used for statistical purposes only. We are interested in group data only. The code number assigned to the questionnaire will be used only to identify non-respondents so that we can encourage them to return the survey form. All numbers are removed upon receipt of the questionnaires. Even if you do not participate in the study, please return the questionnaire. Please be informed that you are free to withdraw your participation at any time during the project activity. All instruments will be destroyed after the data is collected. We would appreciate your help in this study.

The questionnaire should take from 10 to 15 minutes to complete. Please return the questionnaire in the stamped, self-addressed envelope provided by April 30th.

Thank you for your assistance.

Sincerely,

Carlos Rosencrans
Carlos Rosencrans
Teaching Assistant

Robert A. Martin
Robert A. Martin
Professor

PERCEPTIONS REGARDING THE ROLE OF AGRICULTURAL MECHANIZATION IN THE AGRICULTURAL EDUCATION CURRICULUM
PART I

Instructions: Please indicate your level of agreement with each of the following statements by circling the appropriate number following each statement. Please circle "1" if you strongly disagree with the statement and circle "5" if you strongly agree with the statement.

Please use the following scale to express your level of agreement:

1 - Strongly Disagree (SD)
2 - Disagree (D)
3 - Neutral (N)
4 - Agree (A)
5 - Strongly Agree (SA)

	SD	D	N	A	SA
	(Circle one)				
1. Most secondary school agricultural education instructors are under pressure to reduce the amount of time for agricultural mechanics instruction.	1	2	3	4	5
2. Stand-alone courses in agricultural mechanics are critical components of agricultural education programs.	1	2	3	4	5
3. Agricultural mechanics concepts and skills should be integrated into other agriculture courses in the program.	1	2	3	4	5
4. There should be a reduced emphasis in agricultural mechanics instruction on subject content areas relating specifically to production agriculture.	1	2	3	4	5
5. Courses in agricultural mechanics at the secondary level should primarily emphasize the development of employment skills.	1	2	3	4	5
6. Instruction in agricultural mechanization should focus on developing general knowledge and skills that are transferable to a wide range of job clusters rather than specific knowledge and skills that focus on a specific job in a job cluster.	1	2	3	4	5
7. High school students need an opportunity to design, build, and take home projects involving good craftsmanship to develop healthy self-concepts, self-esteem,and pride in quality workmanship.	1	2	3	4	5
8. Instruction in agricultural mechanics should be modeled around a systems concept that addresses basic systems found in complex machines such as fluid power systems, electrical systems, water systems, etc. rather than the traditional areas such as concrete and masonry, hot and cold metals, tractor mechanics, etc.	1	2	3	4	5
9. Courses in agricultural mechanics at the secondary level should be science-based, applied physics with applications in agriculture.	1	2	3	4	5
10. Agricultural mechanics instruction in most high school agricultural education programs adequately addresses the educational needs of both college bound and non-college bound students.	1	2	3	4	5

(Turn to back of page)

AGRICULTURAL MECHANIZATION INSTRUCTIONAL AREAS

PART II

Instructions:

Listed below are selected instructional areas identified in agricultural mechanics at the high school level. You will find two responses to the right of each instructional area. In Column A, indicate whether or not you currently teach skills and knowledge in that area. In Column B, indicate the degree to which you would expand instruction in that area given needed materials and inservice education. Use the scales below to indicate your response. Please respond to both Column A and Column B.

When responding to Column A, circle "Y" if you currently teach in that area. If you do not currently teach in that area, circle "N".

Please use the following scale when responding to the degree to which you would expand instruction in the instructional area, **given appropriate inservice education and instructional materials** (Column B).

1 - No Expansion (NE)
2 - Low Expansion (LE)
3 - Moderate Expansion (ME)
4 - High Expansion (HE)
5 - Very High Expansion (VHE)

	A Currently Taught?		B Degree of Expansion You Would Consider:				
Agricultural Mechanization Instructional Areas	Y or	N	NE	LE	ME	HE	VHE
	(circle one)		(circle one)				
1. Alternative Power Systems	Y	N	1	2	3	4	5
2. Buildings & Structures	Y	N	1	2	3	4	5
3. Climate Controlled Facilities	Y	N	1	2	3	4	5
4. Cold Metal Work	Y	N	1	2	3	4	5
5. Computers (PC)	Y	N	1	2	3	4	5
6. Computer-Operated Machines	Y	N	1	2	3	4	5
7. Concrete	Y	N	1	2	3	4	5
8. Drafting	Y	N	1	2	3	4	5

Agricultural Mechanization Instructional Areas	A Currently Taught? Y or N (circle one)		B Degree of Expansion You Would Consider: (circle one) NE	LE	ME	HE	VHE
9. Electricity	Y	N	1	2	3	4	5
10. Electronics	Y	N	1	2	3	4	5
11. Electronic Monitoring Devices	Y	N	1	2	3	4	5
12. Environmental Systems	Y	N	1	2	3	4	5
13. Greenhouse Operations	Y	N	1	2	3	4	5
14. Hot Metal Work	Y	N	1	2	3	4	5
15. Hydraulics	Y	N	1	2	3	4	5
16. Hydroponics	Y	N	1	2	3	4	5
17. Irrigation Systems	Y	N	1	2	3	4	5
18. Lasers	Y	N	1	2	3	4	5
19. Machine Systems	Y	N	1	2	3	4	5
20. Machinery Maintenance & Operation	Y	N	1	2	3	4	5
21. Multi-Cylinder Engines	Y	N	1	2	3	4	5
22. Plumbing	Y	N	1	2	3	4	5
23. Precision Farming Systems	Y	N	1	2	3	4	5
24. Robotics	Y	N	1	2	3	4	5
25. Safety	Y	N	1	2	3	4	5
26. Small Engines	Y	N	1	2	3	4	5
27. Surveying	Y	N	1	2	3	4	5
28. Ventilation Systems	Y	N	1	2	3	4	5
29. Waste Management Systems	Y	N	1	2	3	4	5
30. Water Systems	Y	N	1	2	3	4	5
31. Welding	Y	N	1	2	3	4	5
32. Woodworking	Y	N	1	2	3	4	5

Please list other Agricultural Mechanics areas you teach, but were not listed:

33. ____

34. ____

35. ____

(Turn to back of page)

PART III

Demographic Data

Instructions: Please respond to the following questions by checking the appropriate answers or filling in the blank to describe your present characteristics.

1. How many teachers of agricultural education are there in your department?

   _______ ONE
   _______ TWO
   _______ THREE
   _______ FOUR
   _______ FIVE OR MORE

2. How many years of experience do you have in teaching agricultural education?

   _______ YEARS OF EXPERIENCE

3. Check your highest educational level attained.

   _______ B.S. _______ M.S. _______ Ph.D.

4. What is your age? _______ YEARS OF AGE

5. Which occupational area best describes your overall agricultural education program?

   _______ AG. SALES & SERVICE
   _______ FORESTRY
   _______ HORTICULTURE
   _______ CONSERVATION & NATURAL RESOURCES
   _______ AGRICULTURAL PRODUCTION
   _______ AGRICULTURAL MECHANICS
   _______ AG. PRODUCTS & PROCESSING
   _______ OTHER: ____________________

6. Currently how many students are enrolled in your agriculture education program?

   _______ STUDENTS

7. Check all facilities you have available for instruction in agricultural mechanics? _______ SHOP

   _______ GREENHOUSE _______ LAND LAB _______ OTHER:__________

8. Do you conduct any adult education programs in agricultural mechanics?

   _______ YES _______ NO

9. Please give additional comments that you feel are important to this study:

   ____
   ____
   ____
   ____
   ____

Please return in the stamped, self-addressed envelope to:

Carlos Rosencrans
206 Curtiss Hall
Iowa State University
Ames, IA 50011

APPENDIX C. REMINDER POSTCARD AND FOLLOW-UP LETTER

April 29, 1996

On April 11, 1996 a questionnaire was mailed to you seeking your perceptions of agricultural mechanics instruction in secondary agricultural education.

If you have already completed and returned it to us, please accept our sincere thanks. If not, please do so today. Only a small sample of secondary agricultural education instructors in the Central States region received this instrument. Therefore, it is extremely important that yours also be included in the study if the results are to accurately represent the perceptions of central states agricultural educators.

If by some chance you did not receive the questionnaire, or it got misplaced, please call me right now, collect (515-382-4695) and I will get another one in the mail to you today.

Sincerely,

Carlos Rosencrans
Teaching Assistant

Robert A. Martin
Professor

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Department of Agricultural Education and Studies
201 Curtiss Hall
Ames, Iowa 50011-1050
Administration and Graduate Programs 515 294-5872
Research and Extension Programs 515 294-5872
Undergraduate Programs 515 294-0024

May 10, 1996

Dear Ag. Ed. Instructor,

On April 11, 1996, I mailed to you a questionnaire related to the role of agricultural mechanization in the Agricultural Education curriculum in secondary schools. To this date, I have not received your complete questionnaire. Perhaps the mailing has been lost or never received.

As I indicated in my initial letter, we are collecting information from agricultural educators within the central states region of the U.S.A. Your response to this questionnaire is essential in determining the perceptions of secondary agricultural educators in your state. I would like to remind you that the code number on the front page of the questionnaire is only there to allow us to keep up with who has and has not responded. Your responses will be completely confidential.

I have enclosed another questionnaire in case the original one was misplaced or lost in the mail. Please complete the questionnaire and return it as soon as possible in the enclosed envelope. If you have already completed and returned it to us, please accept our sincere thanks. If you have any questions regarding this study, please feel free to contact us at (515)-294-0047.

Thanks for your cooperation.

Sincerely,

Carlos Rosencrans
Teaching Assistant

Robert A. Martin
Professor

APPENDIX D. SIGNIFICANT DIFFERENCES TABLE

Table D.1. Significant differences in mean scores between respondents and nonrespondents

Instructional area	Respondent mean S.D.	Nonrespondent mean S.D.	t-value	t-prob.
Alternative Power Systems	2.31 .98	1.46 .88	3.02	.003**
Buildings & Structures	2.69 1.01	1.87 .99	3.05	.003**
Climate Controlled Facilities	2.18 1.06	1.45 .82	2.23	.027*
Cold Metal Work	2.29 1.03	1.87 .83	1.57	.117
Computers (PC)	3.50 1.22	3.00 1.36	1.50	.134
Computer-Operated Machines	2.77 1.30	2.58 1.78	.36	.725
Concrete	2.23 .97	2.07 1.00	.59	.558
Drafting	2.29 1.18	2.00 1.04	.82	.413
Electricity	2.73 .98	2.31 1.25	1.29	.215
Electronics	2.28 1.11	1.92 .90	1.12	.266
Electronic Monitoring Devices	2.32 1.14	1.91 1.14	1.16	.247

Table D.1. Continued

Instructional area	Respondent mean S.D.	Nonrespondent mean S.D.	t-value	t-prob.
Environmental Systems	2.53 1.17	2.33 1.05	.63	.530
Greenhouse Operations	3.14 1.25	2.56 1.21	1.79	.075
Hot Metal Work	2.52 1.10	2.08 1.31	1.31	.190
Hydraulics	2.58 1.08	2.40 1.12	.63	.526
Hydroponics	2.90 1.18	2.40 1.30	1.56	.120
Irrigation Systems	2.01 1.03	1.73 .79	.88	.382
Lasers	2.07 1.18	1.64 1.01	1.30	.195
Machine Systems	2.19 1.00	2.00 1.04	.65	.516
Machinery Maintenance & Operation	2.69 .99	2.36 1.15	1.21	.226
Multi-Cylinder Engines	2.39 1.07	2.33 1.44	.19	.851
Plumbing	2.31 1.09	2.00 1.35	.94	.348

Table D.1. Continued

Instructional area	Respondent mean S.D.	Nonrespondent mean S.D.	t-value	t-prob.
Precision Farming Systems	2.49 1.28	2.67 1.35	-.50	.619
Robotics	2.11 1.20	1.83 1.27	.78	.434
Safety	3.34 1.12	2.88 1.26	1.57	.118
Small Engines	2.76 1.15	2.54 1.13	.67	.505
Surveying	2.55 1.04	1.92 1.12	2.12	.038*
Ventilation Systems	2.23 1.10	1.77 .83	1.48	.141
Waste Management Systems	2.33 1.14	1.77 1.01	1.74	.083
Water Systems	2.31 1.10	1.91 1.04	1.17	.243
Welding	2.85 1.19	2.31 1.45	1.69	.092
Woodworking	2.40 1.15	1.62 .87	2.46	.015*

APPENDIX E. INSTRUCTORS' WRITTEN COMMENTS

The following are instructor responses to question nine, part III: "Please give additional comments that you feel are important to this study." The responses were entered as written.

Number seven on the front pg is very true. I don't have a hard time getting students to work, but I have a very difficult time getting them to take the time and pride to finish it. Number eight - I still find concrete an important teaching unit - a lot of problems with expanding ag mechanics is time, even if I was given more materials - I have tools for hot metal, but no time.

I am a former voc ed student of the program I teach. I have worked in industry since my vo ag teacher helped me get a job in 11th grade, 1974, until I started teaching (this is why I have no college degree). It seems that more and more I spend most of my time teaching my students personal skills, like how to get along with others; following directions; life skills. However mechanical skills are very important. I can place many students with little talent and lots of personality (life skills). But, if my most mech. talented student cannot be personable (on time, follow dir., communicate well, etc.), he will never get a job (or keep one).

In Ohio we are close to losing our extended service. This will impact all aspects of Vocational Agriculture in Ohio.

Ag Mech is an important part of Ag Ed program. Students should have a complete understanding of methods and theory. I use a science related instruction in first two years and a specific approach in last two.

Emphasis is leaning toward higher technology in "blocking" 83 min periods using critical thinking/team projects with less emphasis on testing/lecture more - "hands on" work.

The skills learned through Ag. Mech. are good practiced skills that more students should have. Being able to do some of these skills will prove helpful and save costs for the student in the future.

Although there has been a change to classroom theory instruction, "hands on" ag mech attracts students to our program.

Help! I need a greenhouse for my 125 hort. students - how can one teach without one??! Do you have any ideas, support or funding to help me convince "The powers that be" over here that a greenhouse is essential?!

Good survey - looks like I need to be doing more. My budget is small so I cannot do very much, some areas I would need additional training - I would also need a great deal more equipment.

Teach courses in Physical Science Application in Agriculture and Biological Science Application in Agriculture both for science credit.

We should teach more mechanics and shop skills for (survival), skills - people need to know basics to save money today. Many skills could be taught.

I believe that job skills are important. I teach the girls (and boys too) to change a car tire or to change the oil in their cars.

Biggest problem is schedule for students and size of class, either too big or not enough students.

Expansion of some areas would mean duplication in our school (other departments).

Our local area has a lot of interest and support for hands on Ag Mech. The state higher ups are the only ones that seem to want a reduction.

I believe the Ag program should fit the needs of the community and students, while also stressing areas of competency of the instructor. I found some questions regarding overall Ag Ed difficult to answer.

I am currently employed as an adult instructor.

My first year teaching in H.S. since 1976. The farming community has declined in this area during the last ten years.

Ag mechanics are very important and fun. Being a female I don't have a strong interest, but there are some activities I really like to show my students. Many graduates from universities who teach Ag Ed do not have a strong Ag Mech background. Not much time for emphasis during a college education. Thanks for including us!! I hope this will help you!!

Middle school - not a high school.

We have incorporated mechanics into other programs. Only so many classes to be taught and so many students to go around.

Metals, welding, construction, electricity, small engines, plumbing, electronics, woodworking, robotics, drafting, offset printing, etc, etc, etc, are taught elsewhere in the school. There is no possibility that a school would allow duplication of courses considering available finances.

The courses asked about in this survey are taught in Tech ed and Auto departments.

One night a week taught at our high school.

We are presently expanding to a two teacher department with primary emphasis on mechanics.

I teach in a district with a nuclear power plant. I have all the money and (stuff) I need. I would like to convince the superintendent to hire another teacher as I turn kids away from the program because it's so large and requires time to manage. I need help. Money is <u>never</u> an issue here.

Most of my student get a job in ag Business working hog unit, they still need basic hand tool, elect., weld, repair skill - send them to college to get the tech. area.

Many mechanics areas that I checked no as being taught by myself are being taught by the Ind Arts Dept.

I feel that new college graduates have received virtually <u>no</u> ag. mechanics training in college. This poses a <u>serious</u> liability problem when new teachers may be <u>expected</u> to teach ag. mechanics. Who is liable in the event of serious student injury? - the high school? - the teacher? - the college that <u>certified</u> the teacher? Based on the student teachers which I have had, I am very concerned about their lack of knowledge on shop safety.

Only need time and money to improve, expand, and modernize!!

I only teach classroom Ag Ed three hrs a day.

Due to our Auto Mechanics dept. We do not offer Ag Mech. Our school offers an excellent variety of "voc." oriented courses/departments. I have access to shop and land lab via other "vocational" area departments.

I am part of a program that is in a location in which Agricultural Mechanics is very important to the well being of the community so it must remain a part of the program. We are doing a lot in the Integration Area also.

Teach yr. round Small Engines and a Welding/Electricity class open to all students.

I will have 137 students next year, only one teacher.

We are currently the fourth largest state in ag income, Iowa is second. If we don't teach production ag, who should. I think some places in the US ag production doesn't need to taught but we need strong programs in my state and local.

Please send copies of the results to me. Do not send survey's to Ag teachers in April or May (conventions - contests, banquets, quarter grades, end of year!!!) you'll get better response!

Less than 10% of my students go into production ag. We are missing the boat by not preparing our students for the job.

I teach at a technology center, 11th, 12th, and some adults for the intermediate school district (13 high schools).

Material covered in our program is valuable to any student.

Ag Ed is dieing in Michigan. What programs that are left are so watered down.

I do not have a Ag Mech program and I would not start one due to lack of facilities, money, and my lack of keeping up on technology.

Heavy push to our Ag Mechanics to Technology for 95-96 school year. Their to full technology for next fall.

I feel it is necessary to expand present high school Ag Ed mechanical instruction into such areas as drafting (CAD), pragmatics, hydraulics, robotics, lasers, electronics, etc, simply because of the employment demands in these areas. Most Ag Ed. programs are the only technical programs available in smaller schools!

Expansion would totally depend on funding and I would prioritize. Materials and inservice I would get somehow if equipment was available. Pretty much like every Ag teacher. Sorry for the delay of not doing it the first time!

Many of the Ag Mech courses are still very practical for our students. Need more money for things like robotics.

There needs to be a delicate blend of the sciences and mechanics in the 11-12 grades with more fundamental, production oriented classes in junior high and 9-10 grades.

Ag mech today must be common sense and pertain to possible employment later on. Also it should pertain to skill that will help the individual in their home later on.

REFERENCES

Ary, D., Jacobs, L. C., & Razavieh, A. (1990). Introduction to research in education (4th ed.). Fort Worth, TX: Holt, Rinehart and Winston, Inc.

Beauchamp, G. A. (1983). Curriculum theory (3rd ed.). Wilmette, IL: The Kagg Press.

Bobbitt, F. (1924). How to make a curriculum. Boston: Houghton Mifflin.

Buriak, P. (1992, March). Filling the gap in agriculture. The Agricultural Education Magazine, 64(9), 4, 23.

Burke, S. R., & Hillison, J. (1988). Restructuring the agricultural education curriculum: Implications for agricultural mechanics. The Journal of Agricultural Mechanization, 4(1), 11-17.

Cochrane, W. W. (1979). The development of American agriculture. Minneapolis, MN: University of Minnesota Press.

Curtis, S. M. (1978). A multi-level curriculum model for vocational education in agriculture: "Identifying the strike zone." Journal of the American Association of Teacher Educators in Agriculture, 19(1), 11-16.

Dewey, J. (1938). Experience and education. New York: The MacMillan Company.

Dillman, D. A. (1978). Mail and telephone surveys: The total design method. New York: John Wiley & Sons, Inc.

Doll, R. C. (1992). Curriculum improvement: Decision making and process (8th ed.). Needham Heights, MA: Allyn and Bacon.

Eighmy, M. A. (1995). Strategies for agricultural technology curriculum design in vocational education at the University of Minnesota. Unpublished doctoral dissertation, University of Minnesota, MN.

Gall, M. D., Borg, W. R., & Gall, J. P. (1996). Educational research an introduction (6th ed.). White Plains, NY: Longman Publishers USA.

Gliem, J. (1992, March). Are You teaching science principles or just skills in your agricultural mechanics program? The Agricultural Education Magazine, 64(9), 12-14.

Harper, J. G., & Buriak, P. (1995, November). A discussion paper: Recommendations for agricultural teacher preparation in agricultural systems technology management. Proceedings of the 14th Annual National Agricultural Mechanics Professional Development Seminar (pp. 1-8). Kansas City, MO.

Harper, J. G., & McManus, M. S. (1992, March). Strategies and techniques for teaching how things work. The Agricultural Education Magazine, 64(9), 5-7.

Hass, G. (1983). Curriculum planning: A new approach (4th ed.). Newton, MA: Allyn and Bacon, Inc.

Henry, S. (Ed.). (1995). Agriculture educators directory. Greensburg, PA: Charles M. Henry Printing Company.

Hill, G. C., Harper, J. G., & Symons, W. B. (1988). An analysis of agricultural mechanics research reported in three principal journals in the 1980s. The Journal of Agricultural Mechanization, 4(1), 18-25.

Hirschi, M. C. (1992, March). Physical science and environmental issues in agriculture. The Agricultural Education Magazine, 64(9), 14-15.

Johnson, S. D. (1993). Authentic assessment in technology teacher education. The Journal of Epsilon Pi Tau, 18(2), 8-13.

Kennedy, P. (1993). Preparing for the twenty-first century. New York, NY: Random House.

Krejic, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. Educational and Psychological Measurement, 30, 607-610.

Krueger, D., & Johnson, J. (1992, March). Developing scientific principles in agricultural mechanics. The Agricultural Education Magazine, 64(9), 16-18.

Laird, S. C. (1994). Present and future emphasis of secondary school agricultural mechanics programs in the United States. Unpublished master's thesis, Iowa State University, Ames, IA.

Lawver, D. E., & Fraze, S. (1992, March). Agriscience in agricultural mechanics. The Agricultural Education Magazine, 64(9), 10-11.

Leedy, P. D. (1981). How to read research and understand it. New York: Macmillan Publishing Co., Inc.

Maley, D. (1980). Perspectives on the future: Industrial arts plays a key role in future education. Man/Society/Technology.

McCrory, D. L. (1992). Encyclopedia of educational research. New York: MacMillan Publishing Company.

Miller, G., & Gliem, J. A. (1994, December). Factors related to the mathematical problem-solving ability of preservice agricultural education teachers. Proceedings of the 21st Annual National Agricultural Education Research Meeting (pp. 83-88). Dallas, TX.

Minnesota Department of Education. (1991). Introduction to education that is outcome-based. St. Paul, MN: State of Minnesota Printing Office.

National Research Council. (1988). Understanding agriculture: New directions for education. (National Academy of Science: Committee on Agricultural Education in Secondary Schools). Washington, DC: National Academy Press.

Newman, M., & Johnson, D. (1993, December). Inservice education needs of teachers of pilot agriscience courses in Mississippi. Proceedings of the Twentieth Annual National Agricultural Education Research Meeting (pp. 202-209). Nashville, TN.

Osborne, E. (1992, March). Reshaping agricultural mechanics. The Agricultural Education Magazine, 64(9), 3-4.

Osborne, E. (1994, January). Articulation and integration—the keys to tech. prep. The Agricultural Education Magazine, 66(7), 3.

Ryerson, T. (1991). Model learner outcomes for technology education/industrial education. St. Paul, MN: Minnesota Department of Education.

Savage, E., & Sterry, L. (1990a). A conceptual framework for technology education, part 1. The Technology Teacher, 50(1), 6-11.

Savage, E., & Sterry, L. (1990b). A conceptual framework for technology education, part 2. The Technology Teacher, 50(2), 7-11.

Schnellert, G. L. (1993). Development of a curriculum model for vocational/ technology education. Unpublished doctoral dissertation, Iowa State University, Ames, IA.

Schrader, G., & Litchfield, J. B. (1992, March). Physical science in the study of foods. The Agricultural Education Magazine, 64(9), 7-10.

Sharpes, D. K. (1988). Curriculum traditions and practices. New York: St. Martin's Press.

Shinn, G. C. (1995, November). An examination of curricular issues in the secondary school agricultural mechanics program area: A national delphi using "friendly critics" as a jury of experts. Proceedings of the 14th Annual National Agricultural Mechanics Professional Development Seminar (pp 17-29). Kansas City, MO.

Slocombe, J. W. (1986, December). Agricultural mechanization curricula in 2000 (American Society of Agricultural Engineers No. 86-5515). St. Joseph, MO: The Society.

Spady, W. G. (1977). Competency based education: A bandwagon in search of a definition. Educational Researcher, 6(1), 9-14.

Taba, H. (1962). Curriculum development theory and practice. New York: Harcourt, Brace, and World, Inc.

True, A. C. (1929). A history of agricultural education in the United States 1785-1925. Washington, DC: United States Government Printing Office.

Tyler, R. W. (1949). Basic principles of curriculum and instruction. Chicago: The University of Chicago Press.

Whaley, D., Lucero, D. R., & Rask, G. (1993, July). Blending outcomes based education and tech. prep. The Agricultural Education Magazine, 66(1), 10-11, 14.

Williams, D. L. (1991). Focusing agricultural education research: Strategies for the discipline. Journal of Agricultural Education, 32(2), 7-12.

Wolansky, W. D. (1985). Evaluating student performance in vocational education. Ames, IA: Iowa State University Press.

ACKNOWLEDGMENTS

The completion of this dissertation and my doctoral program is in fact the result of the efforts of numerous people. I would like to thank the following people who made it possible for me to complete my graduate program.

Dr. Robert Martin, who provided leadership as my major professor. A special thanks for your guidance and assistance. Your encouragement and understanding enabled me to keep moving forward on the study. You treated me as a colleague and friend, not just as a graduate student. You were truly the mentor in my program.

Dr. Wade Miller, who served on my committee and as supervisor of my graduate assistantship, a special thanks for always being available to discuss any questions or concerns. Your friendship and support made life as a graduate student easier.

Dr. Greg Miller, who served on my committee, for your thought-provoking questions. Your help and advice enabled me to shed some light on difficult concepts. You helped me to see both the weaknesses and strengths of this study.

Dr. Vic Bekkum and Dr. Alice Fanslow, for serving as committee members and providing assistance and support when needed. Dr. Gaylan Schofield, a special thanks for your help and expertise in computing the statistical analysis of my study.

Greg Vogel, you became the special friend I needed to share both my heartaches and my accomplishments with. You made my entire stay in Iowa much more enjoyable.

Gina Holtzbauer, for your help in data entry and office support. You added so much to the office atmosphere. Cheryl Abrams and Jill King, for your support and encouragement.

I would especially like to thank my wife Deb, who acted as my right hand throughout my entire graduate program. You provided love, support, encouragement and unending faith in my abilities. This would not have been possible without your assistance. My children, Rachel, Richard, William and Katy, for your patience and understanding during my graduate program. My parents, Carlos and Jovita Rosencrans, for your encouragement and support throughout all of my years of study.

And finally, I would like to acknowledge and dedicate this work to Dr. James Dean, who inspired me to pursue the doctorate degree. James, you made it possible and I will always be grateful.